A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

SEPTEMBER, 1937.

GENERAL PHYSICS.

ADSORPTION.

3791. Analysis by Adsorption of the Surface Structure of Graphite. R. M. Barrer. *Roy. Soc., Proc.* 161*A. pp.* 476–493, *Aug.* 20, 1937.—In the sorption of H_2 upon Acheson graphite, from 195 to 71° K.; of N_2 from 273 to 79° K., and of A from 288 to 86° K., there could be observed no dependence of the heat of sorption upon temperature. In each case the heat of sorption was a function of the quantity adsorbed. Commencing at a finite value, it decreased at first rapidly and then less rapidly, tending to a limiting value asymptotically. The initial heats including heats of compression of the gas were: H_2, 2000 cal./gm. mol.; A, 4100 cal./gm. atom; N_2, 4600 cal./gm. mol.; while in these three cases the limiting heats were respectively about 1100, 2400 and 2500 cal./gm. mol. These heats of sorption were not altered by chemisorbing 5 c.c. of O_2, enough to cover most of the active centres had they been O-free C. Reasons are given for regarding the initial value as a sorption in cracks; and the final value as a sorption on plane surfaces. In the sorption region where the sorption heat varied with gas charge an isotherm of the form $p = \{x/(b-x)\}a \exp[-\Delta H/RT]$ was used and found applicable. ΔH, x and p were determined experimentally. The approximate formulæ of London; of Kirkwood; and of Lennard-Jones (for a metal) are used to try to reproduce the experimental values of the heat of adsorption for plane surfaces. That of Kirkwood gave the best agreement. There is evidence of a small energy periodicity on the basal surfaces. Attention is drawn to the necessity of making a complete energy analysis of the surface before computing heats of adsorption. AUTHOR.

3792. Adsorption of Oxygen on Glass. A. van Itterbeek and W. van Dingenen. *Physica,* 4. *pp.* 631–638, *Aug.*, 1937. *In English.*—Measurements are made on the adsorption of O_2 on glass at 90·0° K. and 67·3° K. and for pressures between 10^{-2} mm. and 1 mm. The experimental method is described. The results can be represented by means of a formula of the form $X^2 = k_1k_2p/(1 + k_2p)$, in which X represents the adsorbed quantity per cm^2., p the pressure and k_1, k_2 constants. The constants k_1, k_2 have been calculated by the method of least squares. k_2 seems to be independent of the temperature. From the adsorption isotherms is calculated the adsorption heat at a temperature of 78·6° K. as a function of the pressure. A similar equation for the adsorption isotherms is found by Zeise and by Keesom and Schmidt, but with an expression for X^3 at liquid H_2 temperatures and an expression for X^4 at liquid He temperatures.

AUTHORS.

3793. Heat of Wetting of Activated Silica Gel. D. T. Ewing and G. T. Bauer. *Am. Chem. Soc., J.* 59. *pp.* 1548–1553, *Aug.*, 1937.—An adsorption–desorption curve of water vapour on silica gel showing no hysteresis is obtained. The activity is evaluated for gels of varying water content as heat of wetting measurements. A maximum in the heat of wetting determinations at a water content of 4 % for this particular silica gel is observed. The activation of the gel must be carried out in a manner that the water on the gel is evenly distributed over the surface or at least is in a state of equilibrium with the gel surface energy. Silica gel can be most highly activated by holding it in a vacuum at 260 to 275° for many hours. AUTHORS.

See also Abstracts **3869**, **4114**.

ATOMIC AND MOLECULAR STRUCTURE.

3794. Binding Energies of Atomic Nuclei. Part I. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 557–565, *June*, 1937. *In English.*—The energies of a large number of nuclei are calculated on the assumption that neutrons and protons may be thought of as moving each in a given field of force, while their interaction is only treated as a perturbation. Moreover, the wave functions for each particle are assumed to be the same in each nucleus. In this way a formula is obtained for the binding energy which contains only few unknown parameters, and by fitting these parameters the experimental values are satisfactorily represented. R. P.

3795. Dynamic Fluid Model of Atomic Nucleus. K. Umeda and Y. Ôno. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 715. *pp.* 120–128, *July*, 1937. *In German.*—The fluid model for the atomic nucleus suggested by Thomas-Fermi is treated according to the dynamical method of Bloch [see Abstract 2606 (1933)]. This leads to the characteristic vibration equation, and indicates the frequency of vibration of the fluid sphere, representing the nucleus, to be of the same order of magnitude as that of γ-rays. R. W. P.

3796. Photoelectric Effect of H^2. L. Motz and W. Rarita. *Phys. Rev.* 52. *pp.* 271–273, *Aug.* 15, 1937.—The total photoelectric cross-section of H^2 for an exponential potential is computed with the best available nuclear constants. The value obtained for Th C′. γ-rays is $13 \cdot 1 \times 10^{-28}$ cm^2. AUTHORS.

3797. Nuclear Photoelectric Effect at High Energies. F. Kalckar, J. R. Oppenheimer and R. Serber. *Phys. Rev.* 52. *pp.* 273–278, *Aug.* 15, 1937.—Nuclear transmutations are considered when the energy is so high that the levels of the compound nuclei formed have a spacing smaller than their breadth, and the relations between the cross-sections are investigated for the various possible reactions and the decay constants characteristic of the compound nuclei. When the collision may be treated as a resonance effect, these relations take a simple form. These considerations are applied to the photoelectric disintegration of nuclei of intermediate atomic weight by 17 eMV γ-rays, and it is suggested that the yields should show a marked increase for γ-rays of somewhat lower energy. The formal connection is studied between the evaluation of transmutation probabilities here given and the resonance formulæ appropriate for lower excitation energies, and it is shown that both descriptions may be derived as limiting cases from the same formalism. AUTHORS.

3798. Resonances in Transmutations of Light Nuclei. F. Kalckar, J. R. Oppenheimer and R. Serber. *Phys. Rev.* 52. *pp.* 279–282, *Aug.* 15, 1937.—It is shown that the sharp resonance effects observed in many transmutations involving light nuclei require the existence of fairly strict selection rules to limit the decay rates of the corresponding compound nuclei. Such selection rules in several cases follow from the slowness of the interconversion of spin and orbital angular momentum, Some consequences of this are discussed for the bombardment of B and F by protons. AUTHORS.

3799. Statistics and Nuclear Reactions. V. Weisskopf. *Phys. Rev.* 52. *pp.* 295–303, *Aug.* 15, 1937.—It is possible to apply statistical methods to the calculation of nuclear processes provided that the energies involved are large in comparison with the lowest excitation energies of nuclei. Expressions are obtained for the emission probability of neutrons or charged particles by highly excited heavy nuclei. These expressions are built up in a similar way to the formula for the probability of evaporation of a particle from a body at low temperatures. In applying it to the impact of high energy neutrons on heavy nuclei, the mean energy loss per impact turns out to be $E[1 - 2(a/E)^{\frac{1}{2}}]$ where E is the energy of the incident neutrons and a is dependent on the nuclear structure; we can put approximately $a \sim 0{\cdot}05$–$0{\cdot}2$ MV. The energy distribution of the scattered neutrons is approximately a Maxwellian one with a mean energy of $2(aE)^{\frac{1}{2}}$. AUTHOR.

3800. Disintegration of Aluminium by Polonium α-Particles. W. R. Kanne. *Phys. Rev.* 52. *pp.* 266–270, *Aug.* 15, 1937.—In order to investigate the discrepancies existing in the experiments of Pose and of Chadwick and Constable regarding the protons emitted by Al under α-particle bombardment, the thick target absorption curve for the protons has been repeated. The radioactive source was Po, and an FP-54 vacuum-tube electrometer was used to detect the protons. The structure of the groups observed in the present experiment agrees with the work of Chadwick and Constable, and confirms their interpretation of the results. The ranges of the principal groups are in better accord with those found by Pose. It is suggested that Pose's discrepancies were due to sources which predominantly emitted particles of shortened range, and to an insufficient number of accurate points. An increase in proton yield with the height of the resonance levels has been observed. The relative intensity of the short and long range groups is 4·0, and the difference in energy of any two corresponding groups is 2·4 eMV. AUTHOR.

3801. Atomic Transformations by γ-Rays. W. Bothe and W. Gentner. *Zeits. f. Physik,* 106. 3–4. *pp.* 236–248, 1937.—The γ-rays of about 17 eMV which are produced by the bombardment of Li by protons may possibly in certain substances cause artificial radioactivity. So far as researches yet extend the process consists in the photoelectric splitting off of a neutron. By means of the new transformations some of their half-value times according to already known radioactive nuclei can be arranged in order. Some new radioactive nuclei were discovered. In the case of Br the isomerism of two nuclei is established. J. J. S.

3802. Determination of D_2 in $H_2 + D_2$ Mixtures by the Thermal Conductivity Method. R. Burstein. *Acta Physicochimica,* 6. 6. *pp.* 815–822, 1937. *In German.*—The method of A. and L. Farkas for the determination of D_2, which is based on the different thermal conductivities of the light and heavy isotopes, depends on the proportionality of the resistance of a Pt filament with the pressure at very low pressures. Since the difference between the resistances of the filament in D_2 and H_2 is small the errors may be great, and a better procedure is now described for larger pressures comparable with those employed in measurements of ortho-para hydrogen transformations. Full experimental details are included. H. H. Ho.

3803. Magnetic Scattering of Slow Neutrons. O. Halpern and M. H. Johnson, Jr. *Phys. Rev.* 52. *pp.* 52–53, *July* 15, 1937.—According to well-known theoretical results, atomic or ionic magnetic moments should *per se* contribute to the cross-section for the scattering of slow neutrons. It is suggested that this contribution may be separated from that due to nuclear scattering by a comparison of the scattering of a metal with the scattering from the corresponding ions of different valence. This magnetic scattering should occur in unmagnetised paramagnetic bodies and, in favourable cases, should be several times as great as the nuclear scattering. Accepting the present value for the magnetic moment of the neutron such experiments will yield information concerning the velocity distribution of the incident neutrons. AUTHORS.

3804. Scattering of Neutrons by Deuterons. L. I. Schiff. *Phys. Rev.* 52. *pp.* 149–154, *Aug.* 1, 1937.—The elastic scattering of neutrons by deuterons is considered for energies small enough so that only the $l = 0$ part of the incident wave is different from the corresponding part of a plane wave. The Breit-Feenberg Hamiltonian is used, assuming the same potential between all pairs of particles. Any possible polarisation of the deuteron by the neutron is neglected, although the individual particles in the deuteron are taken into account by an approximate method. This method is capable of including exchange between the two neutrons. When the exchange term is included, the theory gives a cross-section for thermal neutrons two to three times greater than observed; the cross-section for 2·5 eMV neutrons is slightly greater than observed. [See also Abstracts 2807 and 2808 (1937).] AUTHOR.

3805. Neutron Scattering Cross-Section as a Function of Energy. A. C. G. Mitchell and R. N. Varney. *Phys. Rev.* 52 *pp.* 282–285, *Aug.* 15, 1937.—The study of scattering of neutrons of energy range from 0·02 to 80 V from Fe, Ni, and Pb has been completed by measuring the activation of Ag, Rh, and CHI_3 detectors. The scattering of *C* neutrons was determined indirectly by two methods, and the results agreed closely. The scattering cross-section for Ni fell off slowly with neutron velocity, that for Pb increased slightly, while that for Fe remained constant over the range from 0·02 to 80 V. The directional distribution of neutrons emerging from the top of a paraffin cylinder containing a Ra–Be neutron source was investigated by placing detectors at various distances above the top of the paraffin. The results agreed well with those calculated for a cosine distribution law. AUTHORS.

3806. Scattering of Photo-Neutrons from Be by Light Nuclei. E. Fedorov and N. Perfilieva. *Phys. Zeits. d. Sowjetunion,* 11. 6. *pp.* 660–663, 1937. *In English.*—Examination is made of the scattering of photo-neutrons from Be using light scattering elements and compounds ranging from Li to NaCl. The results show that the scattering cross-section does not increase with the atomic weights in the same manner as found by Dunning for fast neutrons or for photo-neutrons scattered by heavy elements. [See following Abstract.] F. C. C.

3807. Scattering of Photo-Neutrons from Be by Deuterium. G. I. Satkovezky. *Phys. Zeits. d. Sowjetunion,* 11. 6. *pp.* 664–666, 1937. *In English.*—Using similar apparatus to that of Fedorov and N. Perfilieva [see preceding Abstract] and spherical iron vessels containing D_2O, the scattering of photo-neutrons (from a glass bulb filled with powdered Be and Pt grains containing 300 mg. of pure Ra) by D_2 was observed with an Ag detector. The mean value for the scattering cross-section is $(4\cdot 7 \pm 0\cdot 6) \times 10^{-24}$ cm^2. F. C. C.

3808. Absorption Coefficients for Thermal Neutrons. C. T. Zahn. *Phys. Rev.* 52. *pp.* 67–71, *July* 15, 1937.—A discussion is given of several integrals arising in the interpretation of experiments on the absorption of thermal neutrons in a $1/V$ absorber. In order to evaluate these integrals they have been expressed in the form of convenient series. There is also given a table of numerical values, which should be useful in the interpretation of experimental data on slow neutron absorption. [See following Abstract.] AUTHOR.

3809. Absorption Coefficients for Thermal Neutrons. O. Laporte. *Phys. Rev.* 52. *pp.* 72–74, *July* 15, 1937.—The integrals for which developments for small values of the argument were given in the preceding paper [see preceding Abstract] are discussed for larger values of the independent variable. Asymptotic series are derived whose main term is of the form $\exp[3(x/2)^{\frac{2}{3}}]$. AUTHOR.

3810. Number of Ra-Be Neutrons. C. J. Bakker. *Physica*, 4. *pp.* 723–729, *Aug.*, 1937. *In English.*—With the aid of a method, developed by Amaldi and Fermi, the number of neutrons, emitted by a Ra-Be neutron source, is measured and found to be $(2\cdot 1 \pm 0\cdot 2) \times 10^4$ neutrons/sec./mc.Ra. AUTHOR.

3811. Bond Orbitals. L. Pauling and J. Sherman. *Am. Chem. Soc., J.* 59. *pp.* 1450–1456, *Aug.*, 1937.—Theoretical energy curves for one-electron bonds between two atoms are calculated for bond orbitals formed by hybridisation of $2s$ and $2p$ orbitals, $3s$ and $3p$ orbitals, and $3s$, $3p$, and $3d$ orbitals, the same radial part being used for the orbitals in a set. It is found that for s-p hybridisation the bond energy is closely proportional to S^2, with S the magnitude of the angular part of the bond orbital in the bond direction. This relation is less satisfactorily approximated in the case of s-p-d hybridisation. It is shown that the energy of a normal covalent bond A-B between unlike atoms is probably represented more closely by the geometric mean of the bond energies for A-A and B-B than by their arithmetic mean. The energy of the one-electron bond in the lithium molecule ion is calculated with consideration of the s p separation to be $1\cdot 19$ eV, and the hybrid bond orbital involved is shown to involve about equal contributions from the $2s$ and $2p$ orbitals of the Li atom. AUTHORS.

3812. Structure of Polyvinylacetate. L. Misch and L. Picken. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 398–404, 1937.—The X-ray diagram of polyvinylacetate is investigated and found to consist of diffuse rings, the innermost of which becomes thickened at the equator when the substance is stretched. Measurements are also made upon the dependence of restoring force upon temperature for various extensions, and the progressive diminution of restoring force and double refraction with time for samples maintained at given extensions is measured. The results obtained indicate a structure similar to that of vulcanised rubber, *i.e.*, chains, partly free and partly forming a network. On stretching the chains become orientated parallel to one another without crystallisation setting in. L. A. W.

3813. Electron Diffraction Investigation of the Fluorochloromethanes. L. O. Brockway. *J. Phys. Chem.* 41. *pp.* 747–762, *May*, 1937.—The results of the measurements on the foregoing compounds are collected in a table, together with those previously obtained for the chloromethanes and for CF_4. The relative certainty of the observed values for the various interatomic distances is indicated by the estimated probable errors. The tabulated values for the bond angles show that in general the Cl-C-Cl angle is larger than the Cl-C-F angle, which in turn is larger than the F-C-F angle. The high electronegativity of F apparently has little effect on the angles betweeen C-F bonds. The F-compounds listed apparently fall into two groups: those having C-F bond distances close to the value 1·41 Å, and those having distances close to the value 1·36 Å. In the first group are methyl fluoride, fluorochloromethane, fluorodichloromethane, and probably also fluorotrichloromethane. In the second group are difluoromethane, tetrafluoromethane, difluorodichloromethane, and difluorochloromethane. The significance of this distinction in the C-F bond distances and the close analogy with the variations in the chemical properties of these compounds have been explained in the previous discussion [see Abstract 1889 (1937)] in the light of a suggested theory of the chemical reactivity of C compounds containing F. AUTHOR.

3814. Molecular Structure of P_4O_6, P_4O_8, P_4O_{10} and As_4O_6 by Electron Diffraction. L. R. Maxwell, S. B. Hendricks and Lola S. Deming. *J. Chem. Phys.* 5. *pp.* 626–637, *Aug.*, 1937.—Molecular structures of P_4O_6 and As_4O_6 are determined from electron diffraction data. P_4O_6 is found to have the symmetry of the point group T_d with an angle $P - O - P$ of $128{\cdot}5 \pm 1{\cdot}5°$, and a $P - O$ distance of $1{\cdot}67 \pm 0{\cdot}03$ Å. In this structure the $P - O$ distances and the P valence angles are preserved with resulting deformation of the O valence angle. The separation of the As atoms in As_4O_6 is found to be $3{\cdot}20 \pm 0{\cdot}05$ Å. Because of the predominant scattering of the As atoms it was difficult to determine the O valence angle, $As - O - As$. Values of 120°, 127·5° and 140° give approximate agreement between the observed and calculated positions of maxima. Electron diffraction photographs obtained from P_4O_{10} differ considerably from those found for P_4O_6. It is not possible to explain all of the features of the P_4O_{10} diffraction pattern by a model having the symmetry of the point group T_d, and it is thought that the structure might be one of lower symmetry. Data are obtained on P_4O_8 which indicate that it has approximately the same electron diffraction pattern as P_4O_{10}. AUTHORS.

3815. Molecular Rotation in Crystalline Disubstituted Ethanes. A. H. White and S. O. Morgan. *J. Chem. Phys.* 5. *pp.* 655–665, *Aug.*, 1937.—The dielectric constants and conductivities of ethylene chloride, bromide, diamine, cyanide, and thiocyanate have been measured over a wide range of temperature in the solid and liquid states and in the frequency band 1–100 kc./sec. Thermal measurements have revealed hitherto unreported transitions in ethylene cyanide at −38° to −46° and in ethylene bromide at −23° to −25°. The ethylene cyanide molecule rotates about all three axes in the crystal between the transition and melting temperatures but the internal rotational motion of atomic groups about the central C—C band, which is believed to characterise this molecule in the liquid state, is not observably restricted by solidification. Such internal motion is believed to facilitate molecular rotation in the crystal by increasing the time-average symmetry of the molecule. An atomic polarisation of about 17 c.c. below the transition is ascribed to the persistence of some degree of torsional vibration within the molecule even in the low temperature phase of the crystal. In none of the other crystals does the polar form of the molecule rotate below the freezing point nor is there evidence of unusual intramolecular motion except possibly in ethylene thiocyanate. It is probable, however, that the *trans* form of ethylene bromide rotates about its long axis between the transition and melting points. H. H. Ho.

3816. Electronic Affinity of the Hydroxyl Group. Part II. J. Goubeau and W. Klemm. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 362–370, 1937.—The calculation of the lattice energy of the alkali hydroxides has been improved with respect to the results of an earlier publication [see Abstract 432 (1937)]. A value has now been found for the heat of hydration of the OH^- ion which is about 2 k.cal. smaller than that of the F^- ion. The remarkably low value of 48 k.cal. is derived for the electronic affinity of the OH group. H. H. Ho.

3817. Constitution of Water in Solutions of Strong Electrolytes. Part II. C. S. Rao. *Indian Journ. Phys.* 11, *pp.* 143–163, *May,* 1937.—A continuation of work previously described [see Abstract 949 (1935)]. The influence on the constitution of water in their aqueous solutions is investigated of the following: $LiNO_3$, LiCl, $CaCl_2$, $CaBr_2$, $NaNO_3$, $NaClO_3$, $NaClO_4$, $HClO_4$. The Raman water band in solutions is always sharper than in the pure solvent, and is usually increased in frequency. For the same concentration of the salt solutions, there is a larger shift of the frequency for $CaBr_2$ than for $CaCl_2$, and for $NaNO_3$ than for $LiNO_3$. The water band is particularly sharp in solutions of $HClO_4$, while among the Na salts examined, $NaClO_4$ made the band most indistinct. The position of the intensity-maximum of the water band in solution is characteristic of the anion, and independent of the nature of the kation. These results are discussed on the basis of a change in water equilibrium and a change of ionic hydration. It is shown that the former is mainly brought about by the anion, and the latter by the kation. A. C. M.

3818. State of Coupling of Molecules in Liquids. A. Piekara. *Acta Physica Polonica,* 6. 2. *pp.* 130–143, 1937. *In German.*—A theory of the variation of orientation polarisation of solutions with concentration is developed on the assumption that there are two kinds of forces between molecules in liquids. Considering a selected molecule, the first kind of forces upon it (Debye forces) are those exerted by a large number of molecules surrounding it and possessing at any given instant a certain special arrangement around it. The second kind of forces (forces of association) are those exerted only by that molecule which at the given instant is very close to the molecule under consideration. The theory is applied to solutions of nitrobenzene in hexane, for which it is shown that the second kind of forces plays the more important part. The variation of the reduction factor R with concentration (R = ratio of orientation polarisation at the given concentration to that at infinite dilution) is calculated from the theory and found to be in good agreement with experimental observation. L. A. W.

See also Abstracts 3831, 3854, 3869, 3906, 3990, 4056, 4058, 4068, 4069, 4072, 4078, 4079, 4109, 4112, 4118, 4120, 4150, 4185.

COLLOIDS.

3819. Use of Mobility Data in Determining the Composition of Colloidal Micelles. B. Cohen. *J. Phys. Chem.* 41. *pp.* 711–713, *May,* 1937.—It has been shown that the fraction of a constituent that is unbound may be determined in a colloidal solution by means of mobility data without including the usual procedure of ultrafiltration and its concomitant assumption. AUTHOR.

3820. Colloidal Solutions of Silver and Copper. H. Freundlich and Dora Steiner. *Chem. Soc., J. pp.* 1081–1085, *July*, 1937.—Highly disperse Ag sols, free from organic substances and suitable as nuclear sols, have been prepared by reducing an ammoniacal silver oxide solution with hydrazine hydrate, provided that small amounts of copper were present (*cf.* the favourable influence of traces of copper for making silver mirrors). Other metals, such as lead and zinc, similarly facilitate the formation of both sols and mirrors. Clear, amicronic, red sols of metallic copper, free from protecting colloids, were reproducibly prepared by reducing an ammoniacal solution of copper oxide with hydrazine hydrate and adding phosphorus (in ether), at higher temperatures. The production of the red copper sol was connected with the primary formation of a yellow sol whose particles, consisting presumably of copper phosphide, act as nuclei. With ammoniacal copper oxide solution and hydrazine hydrate in absence of phosphorus, much coarser copper sols are produced. In these solutions copper mirrors were also readily formed. H. H. Ho.

3821. Ratio of Electroosmotic to Electrophoretic Mobility. A. R. Willey and F. Hazel. *J. Phys. Chem.* 41. *pp.* 699–710, *May*, 1937. —The hydrodynamic theory of electrophoresis is tested with the use of ultramicroscopic particles, and is found to hold. The ratio of electroosmotic to electrophoretic mobility is investigated with the use of these smaller particles. The system used was an unbuffered gelatin–ferric oxide mixture in a Mattson-type electrophoresis cell of pyrex glass. When the gelatin concentration was below about 2 gm./l., electrolyte and pH had a profound influence on this ratio. When the gelatin concentration was above this value, the ratio was unity and independent of electrolyte or pH. It is concluded that to get surfaces that are identical, other than at the isoelectric point, and in the absence of electrolyte, about 2 gm./l. of gelatin is necessary. Since the ratio is unity when identical surfaces are obtained, it is concluded that the factor $1/4\pi$ in the Smoluchowski equation for electrophoresis is correct and that the radius of the particle has no effect on mobility. AUTHORS.

***3822. Purification of Colloids by Electrodialysis. L. Kratz.** *Kolloid Zeits.* 80. *pp.* 33–43, *July*, 1937.—The use and efficiency of two rapid electrodialysers are described. The apparatus is constructed of glass, and solutions of gum arabic, rendered impure by the addition of considerable amounts of acid, alkali or neutral salts, were thereby purified in a short time. The pH values were measured during the electrodialysis, and the influence of the pH value on the conditions of working was determined. The theory of electrodialysis is discussed. F. J. B.

3823. Anomalous Dispersion of Light by Silver Sols. C. Jausseran. *Comptes Rendus*, 204. *pp.* 1646–1649, *May* 31, 1937.— A brief description is given of a method for measuring the difference between the refractive indices of water and of a weak silver hydrosol. The refractive indices found agree, in the case of a sol with 40 $m\mu$ particles, with those calculated by Mie's theory, assuming the optical properties of the disperse phase to be those of bulk silver metal. Indications of anomalous dispersion were found in the spectral region of maximum absoprtion. L. V. C.

3824. Double Refraction in Colloidal Solutions. H. W. Farwell. *J. of Applied Physics*, 8. *pp.* 416–417, *June*, 1937.—Experiments with sols of V_2O_5 and of benzopurpurin between crossed Polaroid plates confirm Kundt's suggestion that in addition to showing stream double-refraction, such sols show double refraction due to particle orientation. The behaviour of such systems is very sensitive and may provide a means of studying fluid flow problems. L. V. C.

3825. Infra-Red Spectrum of Stretched Rubber. D. Williams and R. Taschek. *J. of Applied Physics,* 8. *pp.* 497–505, *July,* 1937.—The absorption spectrum of stretched rubber is studied in the region between 2μ and 8μ. In the case of unilateral stretch transmission measurements indicate that the absorption bands near $3\cdot3\mu$ and 7μ become broader with increasing stretch while the general background absorption becomes more pronounced. Radial stretch is found to produce similar effects in the $3\cdot3\mu$ and 7μ regions while the bands near 6μ become less intense for both unilateral and radial stretch. In the spectrum of rubber stretched radially to approximately 12 times its original area a band is observed near $4\cdot8\mu$ in a region where there is no intense absorption in the unstretched material. Since both absorption and reflection are involved in transmission measurements, it is necessary to determine reflection and extinction coefficients. The results indicate that the reflection coefficient diminishes and the extinction coefficient increases with increasing stretch. The observed variations in the extinction coefficients are of greater magnitude than those to be expected from the known density changes which accompany stretching. Authors.

3826. Viscosity of Raw Rubber. H. M. Smallwood. *J. of Applied Physics,* 8. *pp.* 505–510, *July,* 1937.—Eyring's reaction rate theory of the viscosity of simple and of non-Newtonian liquids is outlined. Mooney's data on the rheology of a sample of raw rubber are shown to be in agreement with Eyring's theory. The data are discussed from the viewpoint of the theory, and some conclusions are drawn concerning the probable mechanism of viscous flow in raw rubber. Author.

3827. Viscosity of Sols made from X-Irradiated Agar. H. Kersten and C. H. Dwight. *J. Phys. Chem.* 41. *pp.* 687–689, *May,* 1937.—Irradiation of dry agar decreases the viscosity of the resulting sol. There is no appreciable " recovery " of the dry agar from the effects of irradiation, at least within 17 days. The effect on the agar is not due to heat emanating from the target of the X-ray tube. Irradiation of the dry agar slightly decreases the pH of the resulting sol. Authors.

3828. Structure of Cellulose. H. Mark and K. H. Meyer. *Zeits. f. phys. Chem.* 36. *Abt.B.* 3. *pp.* 232–236, 1937.—A reply to a paper by Sauter [see Abstract 1440 (1937)] in which he puts forward a new cell-model for cellulose, different from that suggested by the present authors (1928). The work of Sauter is criticised in detail and his results are not accepted. It is pointed out that whereas good agreement is obtained between observed X-ray diffraction intensities and those calculated on the basis of the model of Mark and Meyer, no such agreement can be claimed with Sauter's model. J. I.

3829. Dispersoid Analysis with the Aid of Photo-Cells. E. Hoffmann. *Kolloid Zeits.* 79. *pp.* 154–155, *May,* 1937.—A method is suggested whereby a photo-cell could be used to determine the change with time of the light transmitted by a given thickness of a suspension during the course of sedimentation, and the dispersity so derived. L. V. C.

✱**3830. Simple Super-Centrifuge for Continuous Treatment of Liquids. E. J. Jefferies.** *Journ. Sci. Instruments,* 14. *pp.* 282–284, *Aug.,* 1937.—A simple super-centrifuge for the continuous treatment of liquids is described. The rotor is made of duralumin, the stator of brass.

The rotor is driven by an air blast, actuated by an air pressure of 30–100 lb., and the speed of rotation is 500–850 r.p.s. The liquid to be treated is fed in at the top and the treated liquid flows out at the bottom through a discharge pipe. F. J. B.

***3831. Ultracentrifuge and Study of High-Molecular Compounds. T. Svedberg.** *Nature*, 139. *pp.* 1051–1062, *June* 19, 1937. *Supplement.*—The paper contains a general description of the equipment developed by the author at Uppsala and a review of protein molecular weight data obtained both there and elsewhere. Determinations of molecular weight are made either directly by concentration distribution at equilibrium or indirectly by sedimentation velocity (with independent values of the diffusion constant). For the former experiments, relatively low (up to 20,000 r.p.m.) and for the latter, higher (up to 160,000 r.p.m.) rotational speeds are employed; details of method of drive (electrical or oil-turbine) and of bearings appropriate to different running speeds are given. The course of sedimentation is followed optically, using either the direct light absorption as a function of radius or the schlieren method for illuminating a moving boundary. Molecular complexity depends upon pH and other factors; examples of this are given and tests for homogeneity described. Protein molecular weights are simple integral multiples of 17,600 (multiplier of form $2^m 3^n$), the largest molecules hitherto reported being forms of hæmocyanin with M = 17,600 × 384. L. V. C.

3832. Potential Gradients in Gelatin Gels. Suzanne Veil. *Comptes Rendus*, 204. *pp.* 1645–1646, *May* 31, 1937.—The potential drop in a gelatin gel between parallel electrodes (total field 0·25 V/cm.) is initially uniform except for a pronounced drop at the kathode. After the field has been applied for some hours, the kathode drop becomes greater and a similar anode drop appears, the potential gradient at places remote from the electrodes tending towards zero. L. V. C.

See also Abstracts 3812, 3869, 3882, 4178.

CRYSTAL STRUCTURE AND PROPERTIES.

3833. Structure of Electronic Excitation Levels in Insulating Crystals. G. H. Wannier. *Phys. Rev.* 52. *pp.* 191–197, *Aug.* 1, 1937.—In this article, a method is devised to study the energy spectrum for an excited electron configuration in an ideal crystal. The configuration studied consists of a single excited electron taken out of a full band of N electrons. The multiplicity of the state is N^2. It is shown that because of the Coulomb attraction between the electron and its hole $N^{8/5}$ states are split off from the bottom of the excited Bloch band; for these states the electron cannot escape its hole completely. The analogy of these levels to the spectrum of an atom or molecule is worked out quantitatively. The bottom of the Bloch band appears as "ionisation potential" and the Bloch band itself as the continuum above this threshold energy. AUTHOR.

3834. Lattice Energies and Transition Temperatures of Cæsium Chloride and Ammonium Chloride. A. May. *Phys. Rev.* 52. *pp.* 339–347, *Aug.* 15, 1937.—The lattice energies of CsCl and NH_4Cl are calculated for both the CsCl type and NaCl type lattices, and the temperatures of transition between these two crystal forms determined from the equality of the free energies. This requires the computation of the elastic constants and proper frequencies. In determining the lattice energies, use is made of the method of Born and Mayer, four constants in the lattice energy expression being evaluated from experimental data. To obtain results consistent with known lattice constants, compressibilities and heats of transition, it is found necessary to multiply the van der Waals constants derived by Mayer by about 3·5 and to make the constant coefficient in the repulsion term for nearest like ions about 0·6 that for nearest (unlike) ions. Some success is attained in computing transition temperatures comparable with those known from experiment, but the temperature dependence found for the proper frequencies appears to be faulty. AUTHOR.

3835. Effect of Time-Reversal Symmetry on Energy Bands of Crystals. C. Herring. *Phys. Rev.* 52. *pp.* 361–365, *Aug.* 15, 1937.—In the Hartree and Fock approximations the description of the electronic state of a crystal can be made in terms of one-electron wave functions and one-electron energies, which have a band structure. It is known that in addition to the " sticking together " of these energy bands caused by the spatial symmetry of the crystal, addition " sticking " may be necessitated by the fact that the Hamiltonian of the problem is real. In this paper a criterion is developed to facilitate calculation of when and how such additional degeneracy will occur. The consequences of the reality of the Hamiltonian are tabulated for a number of cases. It is pointed out that the same " sticking together " of bands occurs in the theory of the frequency spectrum of the normal modes of vibration of a crystal. [See following Abstract.] AUTHOR.

3836. Accidental Degeneracy in the Energy Bands of Crystals. C. Herring. *Phys. Rev.* 52. *pp.* 365–373, *Aug.* 15, 1937.—The circumstances are investigated under which two wave functions occurring in the Hartree or Fock solution for a crystal can have the same reduced wave vector and the same energy. It is found that coincidence of the energies of wave functions with the same symmetry properties, as well as those with different symmetries, is often to be expected. Some qualitative features are derived of the way in which energy varies with wave vector near wave vectors for which degeneracy occurs. All these results, like those of the preceding paper [see preceding Abstract] should be applicable also to the frequency spectrum of the normal modes of vibration of a crystal. AUTHOR.

3837. Extension of Bethe's Theory of Order-Disorder Transitions in Metallic Alloys. T. S. Chang. *Roy. Soc., Proc.* 161*A*. *pp.* 546–563, *Aug.* 20, 1937.—In this paper we introduce into Bethe's theory [see Abstract 3259 (1935)], besides the interactions between the nearest neighbours, the interactions between the next nearest neighbours, and calculations are made for the simple cubic and the body-centred cubic systems. A positive V'_B is an effective decrease of V_B, *i.e.*, it decreases the critical temperature. The dependence of kT_c/V_B upon V'_B/V_B is calculated here, and also in the Bragg and Williams approximation. For small values of V'_B/V_B, the two dependences are the same. A few values of V'_B/V_B have been assumed and quantities comparable with the experiments calculated. The agreement is remarkably better than for $V'_B = 0$ (Bethe). It is, however, not expected that they should agree with the experiments too well, for the treatments leave the higher interactions and the heat motions out of account. AUTHOR.

3838. Cobalt and the Cobalt-Carbon System. W. F. Meyer. *Zeits. f. Krist.* 97. 3. *pp.* 145–169, 1937.—The thermal and mechanical transformation of Co is explained by means of the accepted temperature/vapour-pressure curve. By X-ray photographs at temperatures up to 1100° C. it is shown that no second change in modification of Co occurs, although in the case of slightly compressed bars a recrystallisation takes place. When Co is heated in coal-gas at 230°–270° C. a *Mischkristall* Co_xC_y, unstable at room-temperature, and of varying composition is formed. It was found that the decomposition of CO was catalysed by the formation and breakdown of this *Mischkristall* over the temperature range 230°–470° C. From 500° to 800° C. a stable cobalt carbide with a lattice similar to that of Fe_3C occurs. The formation temperature of this Co_3C is shown to be about 550° C. and the lattice parameters are $a = 4 \cdot 52$, $b = 5 \cdot 08$ and $c = 6 \cdot 73$ Å to within $\pm 0 \cdot 5$ %. When benzene vapour is used instead of coal-gas no *Mischkristall* occurs, but Co_3C is formed, its formation being dependent upon the amount of atomic C formed on the Co.

A. G. Q.

3839. Periodic Disturbance in a Cold-Worked Lattice. W. Boas. *Helv. Phys. Acta,* 10. 4. *pp.* 265–267, 1937. *In German.*—The relation between work-hardening and broadening of X-ray spectral lines is investigated theoretically. Intensity measurements show that the decrease with rising order ϵh^2 is *not* continuous according to $e^{-L\epsilon h^2}$, and further, this assumption gives values for internal energy about 30 times too high. A periodic disturbance of r atoms per period p through amplitude a, is assumed. From the Gaussian function a is distributed about the most probable value v, within a distance α according to the relation $e^{-(a-v)^2/\alpha^2}$. Let 4πM be the intensity obtained from an undisturbed lattice and h the order of interference in the disturbed x direction. For total disturbance $p = 0$, and the case is analogous to thermal motion. For a large h, the undisturbed atoms reflect independently of their position, *i.e.*, the periodic r becomes unimportant. From accurate intensity measurements the most probable value of v, the distribution of sharpness α, and percentage of undisturbed atoms might be calculated. Curves are given showing the calculated relation between I/4πM and h for $\alpha = 0$, $p = 0 \cdot 95$ and $0 \cdot 90$ (showing a maximum); and for $\alpha = 0 \cdot 025$ and $0 \cdot 04$, $p = 0$. [See Abstract 1447 (1937).]

D. R. H.

3840. Ternary System Mg-Ag-Cd. F. Laves and K. Moeller. *Zeits. f. Metallkunde,* 29. *pp.* 185–189, *June,* 1937.—A portion of the ternary system Mg-Ag-Cd is examined by thermal analysis and by microscopic and X-ray methods and a phase diagram of the Mg-$AgCd_3$ section is given; the principal features are a solid solution region which extends from pure Mg up to $AgCd_3$; a region of stable crystal types which appear to show dense hexagonal packing; in the neighbourhood of 50 atomic % Mg a structure is observed which appears identical with that of the MgCd phase in the Mg-Cd system and on either side of this composition the structure is similar to the Mg_3Cd type described by Dehlinger. H. J. H. S.

3841. Structure of Sputtered Nickel Films. S. Ogawa. *Tohoku Univ., Sci. Reports,* 26. *pp.* 92–105, *June,* 1937. *In English. Report No.* 423 *of the Research Inst. for Iron, Steel and Other Metals.*—The crystal structures of Ni films sputtered in H_2 or N_2 atmosphere are determined by electron diffraction; the films show hexagonal close-packed structures, having lattice constants slightly different from each other. By annealing in a vacuum, they transform each into the normal lattices. When ground materials, on which films are deposited, are cooled by liquid N_2, the crystal size of Ni films is refined and consequently the diffraction rings are diffused.

The magnetic property of films sputtered in H_2 atmosphere is also investigated. The films deposited on a cooled anode show a face-centred cubic lattice and become more magnetic as the thickness increases, but those deposited on an anode not cooled showed a hexagonal lattice and are always non-magnetic irrespective of their thickness. AUTHOR.

3842. X-Ray Studies on Electrodeposited Chromium and Gold. S. Basu and M. Hussain. *Indian Journ. Phys.* 11. *pp.* 219–230, *July*, 1937.—Electrodeposited Cr and Au are studied by the X-ray powder method, showing some correlation between current density and selective orientation and between hardness and breadth of diffracted lines. White lines, appearing as absorption ones, are reported in photograms of Cr. The origin of these is partially suggested. Au deposits, electrolytically obtained from baths at diifferent temperatures are found to yield diffraction lines, interspersed with spots, confirming thereby the axiom of Bancroft that lowering the temperature diminishes the size of crystal-grains. Intensity measurement has been made for lines of planes 111, 200, 220, 311 and 222 of Au for different temperatures and the sizes of grains are calculated for Cr and Au at different current densities. AUTHORS.

3843. Allotropic Transformation in Boracite, Leucite and Anhydrous Sodium Sulphate Crystals. H. Shôji. *Tohoku Univ., Sci. Reports*, 26. *pp.* 86–92, *June*, 1937. *In English. Report No.* 422 *of the Research Inst. for Iron, Steel and Other Metals.*—The change of lattice-orientation due to the allotropic transformation in boracite, leucite and anhydrous sodium sulphate crystals is investigated. The general relation that when a modification transforms into another, a particular direction in the first crystal becomes also a particular direction (in the same meaning) in the new crystal-lattice is found to hold for the above crystals. AUTHOR.

3844. Optical Demonstration of Transformations in Solid H_2S and D_2S. A. Kruis and K. Clusius. *Phys. Zeits.* 38. *pp.* 510–514, *July* 15, 1937.—Using polarised light the authors obtain evidence that one of the three phases of solid H_2S and D_2S is anisotropic. This result is in contrast to the results of an X-ray crystallographic investigation reported by Justi and Nitka [see Abstract 3423 (1936)]. The latter authors found that all three solid phases of H_2S had a face-centred cubic lattice. The present authors discuss the energy changes involved in the transformations and the data already available on the existence of three solid phases. Details are given of the apparatus used for investigating the polarisation effects of solid gases at the temperature of liquid air. In a brief *Reply*, **E. Justi and H. Nitka** point out that their results indicate that phases II and III have identical cubic lattices in so far as the axial ratio c/a is 1, with an accuracy of about 1 %. They also suggest that a variation in the ratio c/a from 1 of approximately 0·1 % would be sufficient to account for the anisotropy observed by Kruis and Clusius in phase III. J. I.

3845. Mosaic Structure of Rock-Salt. D. B. Gogoberidse. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 621–626, 1937. *In German.*—It is shown that the natural rock-salt crystal is built up of a series of layers which are turned with respect to one another. When the cleavage face is observed in reflected or polarised light at low magnifications these layers are clearly visible as alternate light and dark streaks. Further, it is shown that Laue patterns from wide cleavages and thick crystals consist of asterisms as previously observed by other workers in the case of deformed crystals, and the development of these asterisms from the normal spot pattern is followed. A. G. Q.

3846. X-Ray Study of Potassium Bicarbonate. J. Dhar. *Indian Journ. Phys.* 11. *pp.* 187–191, *July*, 1937.—Crystals of potassium bicarbonate $KHCO_3$ are monoclinic prismatic. The unit cell contains 4 molecules and has dimensions $a = 15 \cdot 01$, $b = 5 \cdot 69$, $c = 3 \cdot 68$ Å; with an angle β of 104° 30′. It belongs to the space group C^5_{2h} ($P2_1/a$). Relative intensity measurements suggest that the CO_3 group should be near the plane (400), having the shape and dimensions as in other normal carbonates and the K atom lies practically in the (010) plane. AUTHOR.

3847. Structure of Rare-Earth Ethyl Sulphates. J. A. A. Ketelaar. *Physica*, 4. *pp.* 619–630, *Aug.*, 1937. *In English.*—The crystal structure of the hexagonal ethylsulphates of the rare earths La, Ce, Pr, Nd, Sm, Gd, Dy and of yttrium is investigated with X-rays. The structure is derived from the observed intensities with the aid of plausible conceptions about interatomic distances. It is found that the point symmetry of the paramagnetic ions and thus also the symmetry of the crystal field acting on these ions is trigonal-dipyramidal (C_{3h}). This conclusion is discussed; a rather improbable deviation from this symmetry could only be caused by an arrangement of the hydrogen atoms based on a larger elementary cell than is found experimentally. AUTHOR.

3848. Structure of Zirconium Silicide, $ZrSi_2$. S. v Náray-Szabó. *Zeits. f. Krist.* 97. 3. *pp.* 223–228, 1937.—Seyfarth's results have been re-examined and shown to be more consistent with a unit cell with a 3·72, b 14·64, c 3·67 Å, containing 4 molecules, space-group D^{17}_{2h}—*Cmcm*. The three atoms all occupy positions 0, y, $\frac{1}{4}$ with $y = 0 \cdot 106$, 0·750 and 0·355 for Zr, SiI and SiII respectively, and forming a layer lattice of uncharged atoms. C. A. S.

3849. Crystallography of Brushite. P. Terpstra. *Zeits. f. Krist.* 97. 3. *pp.* 229–233, 1937. *In English.*—Artificial crystals of brushite, $CaHPO_4 \cdot 2H_2O$ (prepared by a diffusion method), density 2·326, have a 10·3, b 15·4, c 6·4 Å, β 84°53′, with 4 molecules in the unit cell. The crystals are piezoelectric and accordingly, though isomorphous with gypsum, the space group is not C^6_{2h} but probably C^3_2. The groups PO_4H occupy the same positions as SO_4, the O atoms in the former at the angles of a slightly distorted tetrahedron with the H atom in one edge between a pair of O's. $n_a = 1 \cdot 539$, $n_\beta = 1 \cdot 545$. C. A. S.

3850. Structure of 1·2-Diphenylbenzene ($C_{18}H_{14}$). C. J. B. Clews and Kathleen Lonsdale. *Roy. Soc., Proc.* 161*A*. *pp.* 493–504, *Aug.* 20, 1937.—1·2-Diphenylbenzene forms orthorhombic crystals belonging to the space group $P2_12_12_1$. The density is 1·166 gm./c.c. at 17° C., and the unit cell contains four, presumably asymmetric, molecules of $C_{18}H_{14}$, the axial lengths being $a = 18 \cdot 6$, $b = 6 \cdot 05$, $c = 11 \cdot 8$ Å. The intensity of X-ray reflection from many crystal planes was measured but was found to give no clear indication of the molecular or crystal structure. The principal crystal diamagnetic susceptibilities are $\chi_a = -112 \cdot 6 \times 10^{-6}$, $\chi_b = -132 \cdot 3 \times 10^{-6}$, $\chi_c = -210 \cdot 3 \times 10^{-6}$, and these, together with an estimate of molecular susceptibility based on the magnetic anisotropy of benzene, and the dimensions of the unit cell, lead to the following conclusions: (1) Neither of the substituted phenyl groups can be orthogonal to the parent nucleus. (2) The most likely structure is one in which the two phenyl groups have their planes turned in the same direction about 50°, or less, out of the plane of the parent nucleus; the molecular direction bisecting the angle between the two phenyl bonds lies nearly, but not exactly, along the crystal direction a; and the molecule, as a whole, is rotated about this direction in such a way that the planes of the substituted phenyl groups are more or less normal to the *c* crystal axis. AUTHORS.

3851. Non-Planar Aromatic Molecules. Kathleen Lonsdale. *Zeits. f. Krist.* 97. 1–2. *pp.* 91–94, 1937. *In English.*—The author discusses the effect on the plane character of the benzene ring of substituting large or asymmetric groups in the ring. An investigation of crystalline *o*-diphenylbenzene shows that its molecule cannot be plane and the comparison of the results of an X-ray investigation with magnetic anisotropy measurements on *s*-triphenylbenzene seems to show the molecule of this compound also is not quite plane. J. I.

3852. Action of the Magnetic Field and of the Electric Field on Anisotropic Liquid Mixtures. V. Zwetkoff. *Acta Physicochimica,* 6. 6. *pp.* 865–884, 1937. *In German.*—Further investigations were made by the method previously described [see Abstract 1959 (1936)]. It was found that an anisotropic liquid mixture of *p*-azoxyanisol, and of $CH_3.O.C_6H_4.CH.CH.COOH$, as well as some other isomorphic crystalline liquid mixtures, in a thin layer bounded by a glass surface, gave a good normal orientated layer, although the pure components form layers parallel to the glass. By application of a magnetic field to the mixture mentioned it was observed that the elastic characteristics of the mixture with rising temperature fell off more quickly than the magnetic anisotropy of the same. The constant K which defines the elastic characteristics of the mixture is determined not by the percentage content of the components, but by the transformation temperature of the mixture. The values of the elastic constants for the three kinds of deformation of the anisotropic liquid *p*-azoxyanisol were calculated. Through action of an electric field on the mixture it was established that at a definite temperature, dependent on the concentration of the components, the dielectric anisotropy of the mixture changes its sign. [See following Abstract.] J. J. S.

3853. Cause of the Motion of Anisotropic Liquids in the Electric Field. V. Zwetkoff. *Acta Physicochimica,* 6. 6. *pp.* 885–892, 1937. *In German.*—Discussing previous investigations of this subject the author [see preceding Abstract] concludes that one of the chief causes of the motion of anisotropic liquid layers in electric fields is the dielectric anisotropy of the preparation. J. J. S.

3854. Quasi-Crystalline Structure of Liquids and Solutions. F. H. Müller. *Phys. Zeits.* 38. *pp.* 498–510, *July* 15, 1937.—In connection with the Debye theory of hindered rotation, the author investigates the relationship of the potential energy with the other factors concerned in order to derive a presentation of the molecular condition in the liquid state. The propositions now submitted are based on experimental data at small concentrations and in the region of the critical temperature, and refer only to substances which satisfy the van Arkel formula, *e.g.* chlorobenzene, nitrobenzene, the dichlorobenzenes, methyl chloride, etc., Liquids such as the alcohols and ethyl ether exhibit another type of association. The analogy is taken of the structure of a dipolar liquid and that of a strong electrolyte. It is shown that the theoretical clarification of the course of polarisation at small concentrations is only to be expected with simultaneous implication of solvent influence ; it appears that to a first approximation the rotation coupling only depends on the dielectric constant of the dielectric environment, and indifferently as to whether it is caused by the pure solvent as in the case of infinite dilution, or by neighbouring dipoles as in solutions. H. H. Ho.

3855. Coefficients of Fractionation of Salts with Several Hydrates. B. Goldschmidt. *Comptes Rendus*, 205. *pp*. 41–42, *July* 5, 1937.—Barium acetate, to which AcX is added as indicator, is slowly crystallised from a large amount of solution and the ratio λ of the radioactivity of the various crystallised salts to that of the dissolved salt is determined. [See Abstract 5077 (1936).] C. A. S.

3856. Law of Coalescence and Anomalous Mixed Crystals. A. Neuhaus. *Zeits. f. Krist.* 97. 1–2. *pp*. 28–58, 1937.—Detailed results are given of a crystallographic, optical and X-ray investigation of $CoCl_2.2H_2O$ and an optical study of $CuCl_2.2H_2O$ and $2NH_4Cl.CuCl_2.2H_2O$. Very close structural analogies are observed between the lattices of all three compounds. The available data for the single salts are compared with those for the corresponding double salts of the above type in an attempt to obtain some general law regarding the mechanism of the formation of anomalous mixed crystals. J. I.

3857. Crystal Optics. Part IV. General Dispersion Conditions Especially for X-Rays. P. P. Ewald. *Zeits. f. Krist.* 97. 1–2. *pp*. 1–27, 1937.—The general conditions governing dispersion phenomena are discussed theoretically. The author first examines the dynamic theory of X-ray diffraction and states some unsolved problems. Next the questions of the crystal lattice, plane waves, the interaction of dipoles and an optical field are discussed. Then certain fundamental equations are derived and applied to several special cases, before dealing with the general case. Finally the author examines the range of wave-lengths, etc. over which the equations are valid. [For Part III see Abstract 950 (1918).] J. I.

3858. U.V. Absorption Band of Alkali Halide Crystals. E. Rexer. *Zeits. f. Physik*, 106. 1–2. *pp*. 70–92, 1937.—By u.v. illumination just in the edge of the absorption band colour centres are produced in KBr crystals. By this process the absorption coefficient in the edge of the band is increased. When subsequently the colouring is removed by illumination with red light, the absorption is reduced, but not quite to its old value. This process can be carried out repeatedly until finally equilibrium is attained. By this process the efficiency of u.v. light in producing colour centres is increased, and a similar change can be observed in the luminescence yield. From this "excited" state the crystal returns gradually to its initial state if it is kept at room-temperature. These phenomena are structure sensitive; they are affected by plastic deformation. [See following Abstract.] R. P.

3859. Heat Treatment and Diffusion in Salt Crystals. E. Rexer. *Zeits. f. Physik*, 106. 1–2. *pp*. 93–101, 1937.—Crystals of KBr and NaCl are heated for several hours in air, Ga vapour or *in vacuo*. By splitting the crystal it can then be shown that the surface has very different properties from the interior. In particular the surface regions show an increased absorption in the edge of the u.v. band, and increased phosphorescence of a colour which depends on the medium in which the crystal was heated. The conclusion is drawn that this effect is due to the penetration of foreign atoms into the crystal. The penetration is studied as a function of time and the validity of the diffusion laws is verified. [See preceding Abstract.] R. P.

3860. Influence of Alternating Stress on Crystalline State of Metals. F. Wever and H. Möller. *Naturwiss.* 28. *pp.* 449–453, *July* 9, 1937.—Alternating stresses are applied to an annealed mild ingot steel specimen and the alteration in the crystalline state of the steel is detected by an X-ray diffraction method, in which the same crystallite is examined throughout. For loads well below the endurance limit no change in crystalline state is found, but above this limit slight lattice distortion is noted. At the position of the break, marked lattice distortion is noted during the last reversal of stress before the break occurs. It is assumed that a loading limit exists below which no change in the crystalline state can be detected. This limit cannot be far from the endurance limit, but the question of whether the two coincide is not settled. J. T.

3861. Anode Dendrites in Alkali-Halogen Crystals. S. Arzybyschew and B. Wesker. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 627–635, 1937. *In German.*—In investigations of ionic mobilities in alkali-halogen crystals it was noticed that dendrites often formed near to the anode when this was of an easily fusible metal. The authors now describe several examples of these dendrites in rock-salt and in artificial sylvine crystals. In the cases of Te and Bi it is shown that the dendrites are metal particles orientated in a definite manner in the crystals. The influence of *U*- and *F*- electrons on dendrite formation is also studied. [See following Abstract.] J. I.

3862. Migration of Foreign Ions in Alkali-Halogen Crystals. S. Arzybyschew. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 636–646, 1937. *In German.*—The author discusses some suggestions concerning the mechanism of dendrite formation near the anode in crystals of rock-salt and of sylvine when they are subjected to an electric field. Expressions are also proposed which explain the motion of foreign ions in the lattice. [See preceding Abstract.] J. I.

3863. Accurate Determination of Lattice Constants by the Debye-Scherrer Method. K. Moeller. *Zeits. f. Krist.* 97. 3. *pp.* 170–196, 1937.—A detailed investigation of the sources of error in the powder method, and the various methods of overcoming them, is given. The method of mixtures is applied to TlCl, NaCl, LiF and Pt, referred to Ag as comparison material. The discrepancies between the lattice parameters calculated from the different diffractions are shown to be much greater than can be accounted for by errors in measurement. While these variations are less than can be explained in terms of deviations from Bragg's law in symmetrical reflection, they are not dependent only upon the electron density in the crystal as would be the case if this were the true explanation, but also upon the angle between the reflecting Bragg plane and crystal surface and upon the grain size. A full Bibliography of the subject is given. A. G. Q.

***3864. Low Power X-Ray Tube for Wide-Angle Photographs. B. Hess.** *Zeits. f. Krist.* 97. 3. *pp.* 197–207, 1937.—A new type of gas X-ray tube, using only 2–3 W, is described, which is suitable for the taking of wide-angle diffraction photographs. These photographs, which can be used in a direct fashion to determine the lattice dimensions of a substance, are discussed in detail. The target of the X-ray tube is a metal foil set at right angles to the electron stream. The crystal to be examined is placed very near to the target on the side away from the kathode, and the X-ray beam passes through it. The tube runs at 30–35 kV with a current of about 0·1 mA. The primary voltage is only 8 or 10 V. J. T.

3865. Indexing of Powder Photographs. L. K. Frevel. *J. of Applied Physics*, 8. *pp.* 553–557, *Aug.*, 1937.—By taking two successive Debye-Scherrer-Hull pictures of a powder specimen at two different temperatures, one obtains on a single film a direct temperature shift of the diffraction pattern of the substance. An interval of 150° C. or greater will generally suffice to produce easily measurable temperature shifts that can be related to the anisotropy of a crystalline substance. A systematic treatment of the various crystal systems has shown that the first four systems (cubic, tetragonal, hexagonal, and orthorhombic) can be indexed in a straightforward manner. Two cases of the monoclinic system: (1) $\partial\beta/\partial T = 0$ and (2) $a_b/2 = (1/b)\ (\partial b/\partial T) > a_a > a_c > \cot\ \beta\partial\beta/\partial T$ can be solved without time-consuming mathematical calculations. AUTHOR.

See also Abstracts **3791, 3828, 3926, 4029, 4100, 4103, 4108, 4167, 4199, 4203, 4209.**

DENSITY

3866. Densities of Mixtures of H_2O and D_2O. L. G. Longsworth. *Am. Chem. Soc., J.* 59. *pp.* 1483–1484, *Aug.*, 1937.—The densities at 25° of a series of mixtures of light and heavy water have been determined. Contrary to the conclusion of earlier workers the components mix without appreciable change of volume. This fact is used in obtaining a new formula relating the composition of the mixtures to their densities. AUTHOR.

DIFFUSION AND OSMOSIS.

3867. Diffusion of Metal Atoms in Gases at Room-Temperature. E. F. M. van der Held and M. Mięsowicz. *Physica*, 4. *pp.* 559–579, *July*, 1937. *In German.*—Na is made visible by means of a condenser discharge at a pressure of about 1 mm. of Hg in a tube in which it is diffused against a stream of N_2. At room-temperatures the diffusion coefficient is found to be 20·4 cm².$/$sec. This result, in conjunction with that of Ginsel and others [see Abstract 4342 (1933)] shows that a correction for attractive forces must be introduced into calculations of collision cross-sections at high flame temperatures. The collision radius of Na is found to be 1·84 Å. Experiments were also made using discharges from induction coils, but a chemical reaction occurs disturbing the experiment. The same value of diffusion coefficient is obtained, however, if it be assumed that the N atoms have a Schottky distribution over the cross-section of the tube. G. G.

3868. Diffusion Coefficient of Methane and Air. H. F. Coward and E. H. M. Georgeson. *Chem. Soc., J. pp.* 1085–1087, *July*, 1937.—No previous measurement of the coefficient of inter-diffusion between methane and air having been recorded, the results of such experiments on this subject are now presented. The method used was a vertical tube, closed at the ends, being divided horizontally into two halves which could be put into communication or separated as desired. Two gases were allowed to diffuse for a definite period, and the contents of the two halves of the tube were then separated and analysed. On the assumption of Fick's (second) law of diffusion, $\delta c_1/\delta t = D\ \delta^2 c_1/\delta x^2$, the diffusion coefficient D is calculated. Full apparatus details are given together with a table of results. The true value of $D_{0,760}$ is probably close to 0·196 cm².$/$sec. H. H. Ho.

3869. Properties and Functions of Membranes, Natural and Artificial. *Faraday Soc., Trans.* 33. *pp.* 911–1151, *Aug.*, 1937.—A symposium on the subject comprising a total of 33 papers, with Discussions by various contributors, and arranged under two main headings. Of this total the following 18 are selected.

PART I. NATURAL MEMBRANES.

"Electric Impedance of Marine Egg Membranes," by **K. S. Cole** (*pp.* 966–972).—A.c. impedance data over a wide range of frequency are analysed to obtain the electrical characteristics of several components in the eggs of marine forms.

"Electrical Evidence on the Nature and Alterations of Membranes in Large Plant Cells," by **L. R. Blinks** (*pp.* 991–997).—Resistance measurements on large plant cells are described. Transient effects on "make" of d.c. and change of impedance with frequency of a.c. are attributed to some polarisation effect in protoplasm. Directional effects, reversal of p.d. by outward current, the influence of K^+ ion, restorative effects of inward current, and the maintenance of membranes and gradients are discussed.

"Resting Potentials of Muscle and Nerve, and Depolarisation by Various Agencies," by **S. L. Cowan** (*pp.* 1023–1028).—Present knowledge of the resting (injury) potentials of muscle and nerve is summarised and reviewed. There is a discrepancy between the potentials expected in frog muscle and crab nerve and those found experimentally.

"Physico-Chemical Basis of Electrotonus," by **H. Rosenberg** (*pp.* 1028–1035).—A physical theory of the core-conductor model for reproducing electrotonus is developed, and it is shown that the results of recent measurements on nerve are in general agreement with it. The kathodic potential which is manifested as electrotonus may be assumed to be the intrinsic stimulus for the nerve membrane in physiological activity.

"Physical and Chemical Properties of Nerve Fibres and Nature of Synaptic Contacts," by **J. Z. Young** (*pp.* 1035–1040).—A detailed description, based on physical and chemical evidence, is given of the structure of nerve fibre. Diffusion away from the axoplasm is perhaps responsible for injury and action potentials. The existence of a thin layer of radially orientated lipoid molecules around nerves is perhaps of significance in the mechanism of nervous conduction.

"Bioelectrical Properties of Frog Skin," by **R. B. Dean** and **O. Gatty** (*pp.* 1040–1046).—The present knowledge pertaining to the bioelectrical behaviour of frog skin is summarised and reviewed.

"Observations on Skin Potentials in Human Subjects," by **W. F. Floyd** and **C. A. Keele** (*pp.* 1046–1049).—Potentials relative to a fixed point are recorded for different parts of the body surface. Certain "active" regions show potential changes following suitable body stimulation. Effects of skin temperature, area of electrode, and electrode fluid are described.

"Origin of Bioelectric Phenomena," by **K. H. Meyer** (*pp.* 1049–1051).—Action currents are a necessary accompaniment to the chemical reactions assumed to take place in any organ during activity. Changes in permeability of membranes may also occur but are secondary.

Discussion.—**S. L. Cowan** suggested factors which may explain the discrepancy between observed and calculated injury potentials. **J. H. Schulman** indicated how salt concentration differences of suitable magnitude could be obtained in a cell by an adsorption process. **T. Teorell** criticised the term "kation or anion permeable" as applied to membranes;

and pointed out that potentials can be produced during the expansion of thin non-aqueous films interposed between electrolyte solutions. **W. Wilbrandt** described the effect of organic kations on resting potential. **A. V. Hill** said that no extensive chemical change can be the basis of transmission of the nerve impulse. No special mechanism is needed for "action potential," which may be considered due to a momentary change in the surface in the nerve across which the resting potential normally acts. **J. J. Bikerman** suggested an explanation of some of the observations recorded by L. R. Blinks (above). **R. B. Dean** discussed details of experiments described in his paper. **T. Teorell** showed how results obtained by R. B. Dean on frog skin could be explained by regarding the frog skin P.D. as a "mixed membrane potential." **G. S. Adair** described an experiment bearing on those of Floyd and Keele. **S. L. Cowan** reported measurements by B. Katz on depolarisation of Maia nerve by acetyl choline. **W. Wilbrandt** mentioned effects of tetraethylammonium ions. **K. H. Meyer** discussed the nature of the ions taking part in potential changes.

"Radiations, Cell Permeability and Colloidal Changes," by **S. Tchakhotine** (*pp.* 1068–1072).—Results of applying an u.v. micro-ray method to a study of the effect of radiations on various parts of a living cell are described, and the various contributory factors analysed. The action of u.v. light is specific and is only obtained with wave-lengths of about 2800 Å.

PART II. ARTIFICIAL MEMBRANES.

Introductory Paper: "Artificial Membranes: Structure and Permeability," by **K. H. Meyer** (*pp.* 1073–1081).—Work by other investigators is reviewed and an account of the author's recent investigations of the permeabilities of artificial membranes is given.

"Factors in Membrane Permeability," by **E. K. Rideal** (*pp.* 1081–1085).—Experiments with monomolecular films of proteins, cholesterol and of both are described. Fatty acids injected into the substrate penetrate the films and form mixed films in a molecular ratio of 1 : 1. The mixed films are very stable. The mechanism is discussed with reference to membrane permeability.

Discussion.—**E. Manegold** described the permeability of glass membranes. **P. Grabar**: membranes can be prepared from polystyrols. **T. Teorell** pointed out weaknesses in the theories developed by himself and by K. Meyer. **J. J. Bikerman** criticised Meyer's theory. **O. Gatty**: the effect of orientated dipoles depends on thermodynamic equilibrium. **K. H. Meyer** replied to criticisms.

"Effectiveness of Filtration, Dialysis, Electrolysis and their Intercombinations in Purification Processes," by **E. Manegold** (*pp.* 1088–1094).—The efficiency of seven possible processes for purifying a hydrosol contaminated with a molecularly disperse constituent is investigated in terms of the time required to reduce the concentration of foreign matter from its initial to a final prescribed value.

"Principles Governing the Preparation of Membranes having Graded Porosities. Properties of 'Gradocol' Membranes as Ultrafilters," by **W. J. Elford** (*pp.* 1094–1104).—The behaviour of "gradocol" membranes as used as ultrafilters in determining particle size in disperse systems is reviewed, and the derivation and significance of the factors employed in deducing particle diameters from limiting pore diameters are discussed.

Discussion.—**P. Grabar** gave details of methods of preparing membranes not possessing some of the defects shown by "gradocol" membranes. **W. J. Elford** discussed the formation of the polygonal pattern in "gradocol" membranes.

"Theory of Membrane Equilibrium," by **G. S. Adair** (*pp.* 1106–1116).—Rigorous criteria for equilibrium across semipermeable membranes are restated, and certain functions defined. Some terms not usually included in approximate formulæ may be of importance at high pressures or in systems where large molecules can diffuse across the membrane. The theory of membrane equilibrium in ideal systems is applied to dialysis.

"Structure in Relation to Living Biological Functions," by **J. H. Schulman** (*pp.* 1116–1125).—Associations and interactions between large molecules are measured quantitatively by the methods of surface potential and surface pressure. The association takes place between the hydrophobic and polar groups of film and substrate respectively, and the orientated complexes produced are very stable. Experiments on film penetration are described. Effects of biologically active substances injected into the substrate are discussed.

"Protein Films," by **E. Gorter** (*pp.* 1125–1129).—A number of properties of proteins spread as monolayers are described.

"Structure of Protein Monolayers," by **J. S. Mitchell** (*pp.* 1129–1139).—Monolayers of wheat gliadin, zein and insulin are examined by the surface pressure method. Their properties depend on the concentration of the solution from which they are spread, and true homogeneous monolayers of mean thicknesses varying from 1·6 to 3·8 Å are obtained. The mechanical properties and structure of the films are discussed. It is suggested that coordinated H linkages may be formed between peptide groups of adjacent main chains.

"Activation Energy of Diffusion through Natural and Artificial Membranes," by **J. F. Danielli** (*pp.* 1139–1140).—It is shown that a membrane can maintain concentration differences by utilising the heat energy of its surroundings.

Discussion.—**G. S. Adair** and **T. Teorell** discussed experiments on the relationship of membrane potential to the specific properties of the membrane. **J. H. Schulman** suggested a mechanism for association between polar groups in orientated molecules. **N. K. Adam** and **E. Gorter** discussed denaturation of proteins. **J. D. Bernal** thought that film evidence is not yet sufficient for detailed discussion of protein structure. **M. Mathieu** mentioned experiments on the relationship between hæmolytic power and molecular structure. **J. H. Schulman** found that all hæmolytic agents either penetrate or disperse (or both) cholesterol and sphingomeylin films. **O. Gatty** criticised Danielli's interpretation of his results. **J. S. Mitchell** suggested the presence of diketopiperazine rings in proteins, both native and in monolayers. The observed compressibility curves of protein monolayers cannot be accounted for satisfactorily in terms of the "Cyclol" theory. C. B. A.

See also Abstracts 3859, 4018, 4177.

ELASTICITY AND PLASTICITY.

3870. Stresses Produced by Couples in a Layer of Elastic Material. B. Sen. *Calcutta Math. Soc., Bull.* 29. *pp.* 41–48, *March*, 1937.—In this paper, an attempt is made to find the stresses produced by a couple acting on the upper plane surface of an infinite elastic layer of uniform depth '*k*.' The axis of the couple is taken perpendicular to the upper surface and it is supposed that the lower plane surface is rigidly fixed or has no displacement. A brief discussion of the stresses due to uniform distribution of shearing stresses on the upper surface is given.

3871. Sufficiency of the Consistency Equations. B. R. Seth. *Indian Acad. Sci., Proc.* 5*A*. *pp*. 518–521, *June*, 1937.—It is shown that the consistency equations, which are necessary conditions to be satisfied by the stress-components in an elastic solid, are also sufficient. W. G. B.

3872. Theory of Beams Resting on a Yielding Foundation. M. E. Reissner. *Nat. Acad. Sci., Proc.* 23. *pp*. 328–333, *June*, 1937.—After pointing out that the reaction of the foundation at any point is not determined by the local deflection alone, the complete integro-differential equation of the problem is formulated; this equation contains the 'influence function' which represents the deflection of the foundation at any point due to a concentrated load at some other point. An exact formal solution is obtained in terms of the loading on the beam, and of this influence function and of functions simply derived from it, and the particular case where the width of the foundation is equal to that of the beam is worked out in detail. W. G. B.

3873. Effect of Two Isolated Forces on the Elastic Stability of a Flat Rectangular Plate. D. M. A. Leggett. *Cambridge Phil. Soc., Proc.* 33. *pp*. 325–339, *July*, 1937.—Investigates the elastic stability of a simply supported elastic plate under the action of two equal and opposite forces in its plane. An accurate solution is obtained when the plate is infinitely long. This is compared with Timoshenko's approximate solution by strain energy methods; which is found to be 12·5 % too small. The paper illustrates a method which may be used in similar problems where exact results are required. W. G. B.

3874. General Solution for Rectangular Plates. L. Beschkine. *Comptes Rendus*, 204. *pp*. 1918–1920, *June* 28, 1937.—Assuming a state of plane stress, formal solutions giving the deflections and stress-resultants at any point of a rectangular plate acted on by forces and couples applied to its edges are found. W. G. B.

3875. Deformation of Elastic Plates. N. Cioranesco. *Comptes Rendus*, 205. *pp*. 215–217, *July* 19, 1937.—A general method of solution of the equation for the transverse deflection of a uniform elastic plate, under the action of distributed force and couple, when the load can be represented analytically, is sketched. W. G. B.

3876. Equations of Equilibrium of Thin Elastic Shells. F. Odqvist. *Comptes Rendus*, 205. *pp*. 271–273, *July* 26, 1937.—A complete mathematical treatment is given of the theory of thin elastic shells independently of Bernoulli's hypothesis on which the general is based and which leads to a contradiction which requires for its elimination the introduction of second order terms. N. M. B.

3877. Torsion of a Curved Rod. B. Sen. *Phil. Mag.* 24. *pp*. 263–272, *Aug*., 1937.—The curved rod discussed consists of a sector of a circular ring formed by the surfaces $r = a$, $r = b$ and $z = \pm c$, the equations being expressed in cylindrical coordinates. A method of successive approximation has been given by O. Göhner in solving torsion problems of curved rods of different forms of cross-section and in the present paper an exact solution of the torsion problem for the curved rod described is obtained in terms of a convergent series, a few terms of which are sufficient for computation to the required degree of accuracy. H. J. H. S.

3878. Free Vibrations with Non-Linear Elasticity. A. Gemant. *Phil. Mag.* 24. *pp.* 272–281, *Aug.*, 1937.—The paper contains a discussion of free non-linear vibrations, the restoring force assumed to be proportional to any power of the displacement. Simple formulæ are derived, allowing immediate computation of the natural frequency for any value of the exponent and for any amplitude. A physical application of the results is given by evaluating the (classical) energy distribution function for a great number of non-linear molecular oscillators of the type concerned. AUTHOR.

3879. General Proof of St. Venant's Principle. J. N. Goodier. *Phil. Mag.* 24. *p.* 325, *Aug.*, 1937.—A modified proof avoiding unessential implications is given. [See Abstract 2368 (1937).] W. G. B.

3880. Elasticity Modulus and Damping of Vibrating Metal Rods. F. Förster and W. Köster. *Naturwiss.* 25. *pp.* 436–439, *June* 25, 1937.—Under small loads the elasticity modulus and logarithmic decrement of paramagnetic metals and alloys are independent of the amplitude of vibration, whereas in ferromagnetic materials they alter with amplitude in the same way as the magnetostriction; a series of curves for the reversible Ni-Fe alloys is given in illustration. [See also Abstract 2373 (1937).] H. J. H. S.

3881. Elastic Constants of Ferromagnetic Substances. I. Šimon. *Zeits. f. Physik*, 106. 5–6. *pp.* 379–394, 1937.—An extension of a research by Petržilka [see Abstract 904 (1936)] in which small thin rectangular plates of magnetostrictive metals are set in vibration in a h.f. magnetic field. The plate vibrates like a bar of the same length or breadth, and it may also be made to vibrate in both directions simultaneously, if the lengths of the sides are in the ratio of two integers. The apparatus used included a h.f. generator, a vibration indicator and a wave-meter. Expressions are given for the three respective wave-lengths. With a knowledge of these and the dimensions and density of the plates, the values of Young's modulus and Poisson's ratio were found for two nickel plates, and two steel plates containing C, Mn and Si. These are compared with results found by other methods. G. E. A.

3882. Mechanical Properties of Flour Dough. R. K. Schofield and G. W. S. Blair. *Kolloid Zeits.* 79. *pp.* 148–154, *May*, 1937.—Earlier studies which are reviewed at length [see Abstract 2378 (1937)] emphasised the importance of the relaxation time (viscosity/rigidity) which, in relation to the duration of the applied forces, determines the resulting plastic and elastic deformations. The structure of dough contained two main elements, a starch paste permeating a network of gluten. The present experiments, permitting the very slow application of small stresses to a cylinder of dough, showed the starch paste to have a critical flow-threshold, giving rise to elastic hysteresis. In addition, the breakdown of the gel skeleton which forms on standing giving rise to elastic fatigue appears to be of thixotropic origin; the effect was partly concealed by an increase in elastic modulus " (strain-hardening ") due probably to the renewal of the gluten network. The mechanical properties of dough were also more influenced by age and by moisture content when small forces rather than large were applied during the measurements. L. V. C.

*3883. **Quantitative Glass Strain Analyser. C. F. Baldwin.** *Gen. El. Rev.* 40. *pp.* 319–320, *July*, 1937.—An arrangement is described for measuring strains in cylinders of transparent materials. It consists of a polariser and compensator, the former being a light-polarising element (thin film type) and the latter a similar film, so rotated with respect to the first as to give the crossed-Nicol extinction effect, together with a system of thin crystalline quartz wedges so cut and arranged that their optical axes are at right angles to each other. Straight and parallel interference lines are observed at the viewing end if the specimen is unstrained, but if strain is present a displacement of the lines occurs, to an amount which is proportional to the stress. The details and assembly of the various components are described, as well as the mode of calibration. Illustrations are given of its use and various applications are suggested. H. J. H. S.

3884. Doubly Refracting Materials. R. D. Mindlin. *J.O.S.A.* 27. *pp.* 288–291, *Aug.*, 1937.—It is shown that when doubly refracting materials are examined with the assistance of a pair of retardation plates if these latter are not accurately quarter-wave plates then not only will the isoclinics not be completely removed but also the retardation fringes will probably change. This effect is obviously of importance in calculating stress magnitudes in photoelastic work from fringe shifts. A. H.

3885. Fracture of Glass Plates by Percussion. T. Okaya and K. Ishiguro. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 573–591, *June*, 1937. *In French.*—Further results [see Abstract 1502 (1937)] are given on the breaking of square glass plates by impact of a needle point attached to a metal cylinder. Usually the break is a simple fracture of harmonic order N, but sometimes combines two harmonics. The number of lines of fracture does not coincide with the order of the harmonic. The theory is to be given in a subsequent paper. F. S.

***3886. Plane Bending Apparatus with Interferometer Strain Recorder. J. W. Cuthbertson.** *Journ. Sci. Instruments*, 14. *pp.* 268–275, *Aug.*, 1937.—Apparatus is described for the accurate determination of the modulus of elasticity of Babbitt metals and similar materials both at room and at elevated temperatures. A bar of the material is subjected to bending stresses and the deflection is measured by an improved form of interferometer. AUTHOR.

3887. Sub-Permanent Deformations (Reactive Phenomena). J. Galibourg and P. Laurent. *Comptes Rendus*, 205. *pp.* 217–219, *July* 19, 1937.—The authors differentiate between three types of deformation under load, elastic, plastic, and sub-permanent. The substance plexigum A, derived from metacrylic acid, has practically neither elasticity nor plasticity, and its load-extension properties have been studied. The extension y under load P at time t after the application of the load is found to be given by the formula $y = Ae^{-\alpha/t} + B \log_e(1 + t)$, where A and B are functions of the load, and α is a constant. Except when t is very small (greater than a minute) this implies that deformation is resisted by internal forces varying as the square of the velocity. If the load is removed when the extension is y_0, the extension at any subsequent time t is represented by $y = y_0(1 - e^{-\alpha/t})$, α having the same value as above. W. G. B.

3888. Thermal Stresses in Cylindrical Pipes. H. Poritsky. *Phil. Mag.* 24. *pp.* 209–223, *Aug.*, 1937.—The steady-state temperature stresses in a cylindrical tube are considered. It is assumed that the temperature is independent of distance along the axis of the tube, and that the coefficient of thermal conductivity as well as Y and σ are constant. Under these conditions a complete analytical solution is obtained. H. J. H. S.

See also Abstracts 3812, 3825, 3931, 3934.

GRAVITATION.

See Abstracts 3906, 3920.

HYDRODYNAMICS AND AERODYNAMICS.

3889. Mechanics of Liquids and Gases. Part II. L. Schiller. *Die Physik,* 5. 3. *pp.* 63–86, 1937.—Recent developments in theoretical and experimental hydrodynamics are briefly reviewed. Among the subjects discussed are: non-viscous flow and more especially flow characterised by the existence of a potential, surface waves, spin, viscous flow and the measurement of viscosity, flow in tubes, obstacles to flow, boundary layers, conditions determining the production of turbulence, aerodynamics, measurement of flow, dynamics of gases, cavitation and diffusion. [For Part I see Abstract 4356 (1933).] J. S. G. T.

3890. Turbulent Motion in an Incompressible Fluid. A. Izakson. *Techn. Phys., U.S.S.R.* 4. 3. *pp.* 239–249, 1937. *In English.*—The paper is concerned with quantities called by the author "moments of connection," which are the average values of the nine products of a turbulent velocity component at a point P by a turbulent velocity component at a point Q. This tensor is split into its symmetrical and antisymmetrical parts, and from the equation of continuity six equations are deduced connecting the nine quantities, as in the work of Keller and Friedmann on compressible fluids (*Proc. First Internat. Congress of Applied Mechanics, Delft,* 1924, *p.* 395). In the present paper the work is carried out in cylindrical polar coordinates, and is applied to fully developed turbulent flow in a circular pipe. From certain assumptions of symmetry for the mean flow and the "moments of connection," the author deduces that the circumferential turbulent velocity component is independent of the azimuth, and, with a further assumption, that the radial turbulent velocity component must be zero. The hypotheses involved in the calculations cannot, therefore, all be correct, and according to the author the space derivatives of the velocity components must become discontinuous on one or more surfaces. S. G.

3891. Turbulent Flow in a Channel. A. Izakson. *Techn. Phys., U.S.S.R.* 4. 3. *pp.* 250–251, 1937. *In English.*—v. Kármán's formula for the mixing length in turbulent flow in a channel cannot hold over the middle fifth of the width of the channel. S. G.

3892. Waves in a Circular Canal. B. R. Seth. *Phil. Mag.* 24. *pp.* 288–293, *Aug.,* 1937.—The transverse oscillations of water in a canal of circular cross-section are studied. There is no exact stable type of oscillation but, if the depth of water be small compared with the diameter of the canal, an approximate determination of the frequency of oscillation is possible. G. C. McV.

3893. Influence of Small Viscosity in a Fluid on the Determination of the Pressure in a Particular Region. Maria Pastori. *Accad. Lincei, Atti,* 25. *pp.* 261–268, *March* 21, 1937.—Two cases are considered, namely motion from a free source and a current traversing a circular obstacle. W. A. R.

3894. Navier's Equations and the Dissipation Function in Hydraulics. Thermal Phenomena Produced in a Fluid by Rapid Motion. P. Vernotte. *Comptes Rendus,* 205. *pp.* 21–23, *July* 5, 1937.—Navier's equations do not apply in the theory of hydraulics if the velocities are given their macroscopic values, and hence the calculation of the dissipation function fails, under these conditions. The equations can, however, be made to apply by the introduction of a supplementary term in the form of a new force. This is illustrated by the consideration of the two-dimensional flow of flow of incompressible fluid between two infinite horizontal planes, one of which moves with velocity U. The consideration advanced can be applied generally, but the dissipation function cannot be expressed in terms of the velocities only. **Errata,** *ibid. p.* 343, *Aug.* 2, 1937. J. S. G. T.

3895. Phenomena of Beats Accompanying the Formation of Bénard-Kármán Alternate Vortices. M. T. Solier, L. Castagnetto and M. Sabathe. *Comptes Rendus,* 205. *pp.* 23–25, *July* 5, 1937.—Phenomena associated with the beats produced by the flow of fluid past an obstacle, producing a Bénard-Kármán vortex street, are illustrated. Certain of the phenomena are attributable to interference between vortices of two different periods. J. S. G. T.

3896. Auto-Oscillation in Fluid Jets. F. J. Bourrières. *Comptes Rendus,* 205. *pp.* 111–113, *July* 12, 1937.—Experiments are described and discussed wherein a coloured thread is obtained in a parabolic-pathed jet. Auto-oscillations develop which express themselves as folds in the coloured thread. The elimination of the coloured portion of the jet, beyond the field of the above observations, is studied. W. A. R.

See also Abstracts 3929, 3930, 3982, 4106, 4125.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***3897. Photoelectric Comparator. R. Roure, L. Quevron and R. Gense.** *Comptes Rendus,* 205. *pp.* 131–133, *July* 12, 1937.—An apparatus is described for converting linear variations into changes in photoelectric current. It comprises an optical system in which an image of a diaphragm is focused in the plane of a knife edge, behind which is a photoelectric cell. To avoid errors due to fluctuations in the light source and to provide a stable zero, two cells are arranged in an a.c. bridge circuit which is coupled to a l.f. amplifier; the knife edge is placed in front of one of these cells. A small travel of the knife edge reduces the amount of light falling on the cell and the resulting change of photoelectric effect, after amplification, is made to actuate a milliammeter or other recording device. A displacement of the knife edge by 1 micron causes a variation of 0·04 mA. in the arrangement described, although, by suitable adjustment, measurements of displacements of the order of 1 mm. may be made. H. J. H. S.

See also Abstract 4034.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3898. Exponential Function of the Differential Operator and its Application to Physical Problems. T. Sakurai. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 511–541, *June,* 1937. *In English.*—A discussion is given with the object of defining the operation with $\exp(h\cdot d/dx)$ on any function suitable for solving physical problems. J. J. S.

3899. Fluctuation Formulæ for Statistical Assemblies. M. S. Bartlett. *Cambridge Phil. Soc., Proc.* 33. *pp.* 390–393, *July,* 1937.—A mathematical note on the study of statistical distributions. As an example the partition function for the energy of the simple linear harmonic oscillator is considered. J. J. S.

3900. Method for Representing Four Variables in Three Dimensions. A. H. Scott. *Rev. Sci. Instruments*, 8. *pp.* 248–250, *July*, 1937.—A simplified method of presenting three variables in two dimensions is the contour map. Two of the variables are plotted as rectangular coordinates and the third variable is represented by a set of isograms which connect points having equal values of that variable. This method of representation can be extended to four variables. If the fourth variable is plotted in the vertical direction, the isograms are replaced by equal-value surfaces. In constructing a model to represent the four variables, the outer equal-value surfaces, which would interfere with the visibility of the others, may be left to the imagination, and only the lines of intersection of these surfaces with the various planes need be represented. Thus, light stiff wires may be used to connect isograms of equal value as an aid to visualising the equal-value surfaces, the isograms being drawn on celluloid sheets mounted parallel and at the appropriate spacing in a metal frame. J. S. C.

3901. Trilinear Coordinates. H. Aiken. *J. of Applied Physics*, 8. *pp.* 470–472, *July*, 1937.—Apart from the well-known use in representation of the constitution of ternary alloys where $x + y + z = 100$, the method is applicable to any system where $xyz = a$ since $\log x + \log y + \log z = \text{const.}$ and reduces to the first case if logarithmic ruling is used. This is convenient for classification of thermionic valves. Further, the system $x + ay + bz = c$ $f(x, y) = 0$, common in heat and energy balances, transforms into $x + y \sin(\alpha + \beta)/\sin\beta + z \sin\alpha/\sin\beta = \mathrm{S}\sin\alpha$. Similarly $x^n y^m z^p = a$ transforms into the manageable form $\log x + (m/n) \log y + (p/n) \log z = \text{const.}$ A particular instance is the possibility of plotting $\mathrm{B} = \mu\mathrm{H}$ as a single curve. D. R. H.

3902. Series and Integrals for Associated Legendre Functions of the First Kind, Regarded as Functions of their Orders. T. M. MacRobert. *Phil. Mag.* 24. *pp.* 223–227, *Aug.*, 1937. See also Abstract 1476 (1936).

3903. Hermite Polynomials. E. U. Condon and R. Greenwood. *Phil. Mag.* 24. *pp.* 281–287, *Aug.*, 1937.—The theory of the Hermite polynomials is developed by means of an application of symbolic operator methods. G. C. McV.

3904. Bessel Function Zeros Derived from Wave Functions. R. P. Bell. *Phil. Mag.* 24. *pp.* 299–304, *Aug.*, 1937.—Some properties of the zeros of Bessel functions are derived from the solutions of Schrödinger's wave-equation for a particle of given mass and energy enclosed in a rectangular box. G. C. McV.

3905. New Electrical Metrology and the M.K.S. System. G. Giorgi. *R.G.E.* 42. *pp.* 99–108, *July* 24, 1937.—In an earlier article [see Abstract 5421 (1936)] the author presented a critical review of the different systems of electrical and magnetic units and showed that none of these is entirely satisfactory. The present article sets forth the considerations on which is based the M.K.S. system proposed by the author and adopted by the International Electrotechnical Commission. The advantages of the new system are stated. The evolution of the theory of concrete magnitudes is explained. The laws of action at a distance and specific magnitudes follow from the relations between the concrete magnitudes, and the expressions for dimensions are simplified and rationalised. The choice of the fourth fundamental unit is discussed, and attention is drawn to the convenience of the ampere and the weber in the M.K.S.

system. A list is given of the numerical values of various physical and electrical magnitudes in M.K.S. units. R. E. N.

3906. Physical Constants. P. Jordan. *Naturwiss.* 25. *pp.* 513–517, *Aug.* 6, 1937.—The dimensionless numbers which may be constructed out of such natural constants as the charge of the electron, Planck's constant, the constant of gravitation, etc., are listed and the objects of Eddington's researches on the relations between them are mentioned. G. C. McV.

***3907. Electrical Calculator. H. Bode.** *Zeits. f. angew. Math. u. Mechanik,* 17. *pp.* 213–233, *Aug.*, 1937.—An electrical calculating machine for solving systems of symmetrical linear equations is comprehensively described. The basis of the system is to construct electrical networks such that the equations for the voltages and currents in their arms correspond to the equations required to be solved. By measuring currents and voltages the analogous equations are solved. L. E. C. H.

***3908. Time-Lag in a Control System. Part II. D. R. Hartree, A. Porter, A. Callender and A. B. Stevenson.** *Roy. Soc., Proc.* 161*A.* *pp.* 460–476, *Aug.* 20, 1937.—Previous work [see Abstract 4539 (1936)] on the effect of a time-lag on the operation of a control system is extended to a more general law relating the behavior of the quantity controlled and the consequent operation of the control system. As before, the behaviour of the quantity controlled can be expressed in terms of the superposition of a set of damped harmonic "normal modes." Ranges of values of the control parameters which promise to give good control can be selected by inspection of contour diagrams giving the damping and frequency of one or two normal modes of lower frequency, and a closer examination of the behaviour of the control system with any set of parameters can then be made by the solution of the control equations on the differential analyser. A large number of such solutions has been carried out and an optimum set of control parameters is stated. The modified control law appears to have some advantage over that previously investigated, from the points of view both of the kind of control obtainable and of the design and operation of the control gear. A method of obtaining in practice a control law of the form studied is briefly indicated. AUTHORS.

See also Abstracts 3808, 3809, 3918, 3928, 4192.

MECHANICS, CLASSICAL.

3909. Periodic Motion in Functional Dynamics. W. H. Watson. *Phil. Mag.* 24. *pp.* 26–34, *July,* 1937.—Functional dynamics treats of the motion of lines in three dimensions. The author discusses the functional analogues of the simple harmonic motion of a particle, the simple pendulum and the propagation of transverse waves along a wire. A. J. McC.

3910. Vibrations of a Rotating Rope. A. C. Stevenson. *Phil. Mag.* 24. *pp.* 293–299, *Aug.*, 1937.—A rope is whirled at a high speed round a vertical axis, gravity being neglected. The equations of motion for slight disturbances of this steady motion, and their solution, are worked out. G. C. McV.

3911. Path of the Centre of Gravity of a Projectile. M. Kurenskij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 6–7. *pp.* 307–311, 1937. *In French.*—A number of formulæ with corrections, including that for the variable density of air, are developed, which can be evaluated by calculation or with the help of existing tables of data. N. M. B.

MECHANICS, QUANTUM.

3912. Perturbation by Boundary Deformation as a Problem of Proper Values. L. Brillouin. *Comptes Rendus*, 204. *pp.* 1863–1865, *June* 21, 1937.—The problem of a perturbation consisting of a modification of the boundary and limiting conditions while the Hamiltonian operator is unchanged is correlated with the ordinary case of a perturbation consisting of a small modification of the Hamiltonian. N. M. B.

3913. Generalisation of Dirac Operators. J. Roubaud-Valette. *Comptes Rendus*, 204. *pp.* 1921–1923, *June* 28, 1937.—A generalisation for five-dimensional space is developed, and the case of a material particle is considered. [See Abstract 2965 (1937)]. N. M. B.

3914. Electronic Model in Dirac's Wave Mechanics. T. de Donder and J. Géhéniau. *Comptes Rendus*, 205. *pp.* 30–32, *July* 5, 1937.—It is shown that the Jacobi equation in the dynamics of a Dirac electron [see Abstract 511 (1937)] is the Jacobi equation relative to the differential equations of a variational principle. N. M. B.

3915. Mutual Potential Energy Between Two Deuterons. K. Umeda, S. Tomonaga and Y. Ôno. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 712. *pp.* 87–96, *July*, 1937. *In German.*—The exchange and van der Waals energies between two deuterons is calculated, using the Heisenberg model and taking account of the proton-neutron force. If the centres of gravity are indeterminate and the spins antiparallel the two deuterons reduce to an α-particle. For exactly determined centres of gravity the van der Waals energy exceeds the exchange energy [see following Abstract]. G. C. McV.

3916. Exchange Integral. S. Tomonaga and K. Umeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 713. *pp.* 97–102, *July*, 1937. *In German.*—The conditions are investigated under which the centres of gravity of two atoms of finite mass can be determined precisely without the exchange integral losing its Heitler-London character. The result obtained shows why, in the case of two deuterons, the exchange integral must vanish when the centres of gravity are accurately determined. [See preceding Abstract.] G. C. Mc.V.

3917. Statistical Geometry and Quantum Electrodynamics. A. March. *Zeits. f. Physik*, 106. 1–2. *pp.* 49–69, 1937.—An attempt is made to modify the geometrical assumptions underlying the usual theory of the electromagnetic field in such a way that points which are separated by less than the classical electron radius are indistinguishable. In this way the difficulties connected with the infinite self-energy of the electron can be avoided. It is claimed that the particular procedure adopted is Lorentz-invariant, but no proof of its invariance is given. R. P.

3918. New Treatment of Exchange Phenomena. H. Ostertag. *Zeits. f. Physik*, 106. 5–6. *pp.* 329–342, 1937.—A general non-commutative algebra of the exchange operators is developed, applicable to the many-electron problem. G. C. McV.

3919. Computation of the London Dispersion Forces for Small Atomic Distances. H. Hellmann and K. Majewski. *Acta Physicochimica*, 6. 6. *pp.* 939–953, 1937. *In German.*—The attempt is made to establish the theoretical limits to the applicability of the asymptotic expression for the energy of the London dispersion forces. At the larger distances this expression gives the available region of the dispersion forces. The present calculation shows that in addition to the higher multipoles, there is under all circumstances an exchange effect to be considered, which is limited by neglect of the development of perturbation energy with falling powers of the atomic distance. This exchange effect, when the atoms are very near together, limits the growth of the dispersion forces. The influence of the exchange effect upon the dispersion forces, as well as the classical polarisation of the atom, is small for the nuclear distances of atoms similar to those of the inert gases. It appears possible for structures without free valency, to carry out in a simple manner a practical useful calculation of the dispersion energy for short atomic distances by neglecting the exchange effect. H. H. Ho.

See also Abstracts 3833, 3903, 3904, 3906, 3921, 4073, 4074, 4183, 4205.

RELATIVITY AND ETHER.

3920. Extension of the Gauss-Whittaker Theorem. A. Lichnerowicz. *Comptes Rendus*, 205. *pp*. 25–27, *July* 5, 1927.—Whittaker has shown how Gauss's theorem of the flux of force in a Newtonian field can be extended to a static field in which the metric, ds, is of the form given by Levi-Civita [see Abstract 1996 (1935)]. It is now shown how the theorem can be extended to static fields of the most general type, and even to certain non-static types of field. J. S. G. T.

3921. New Form without Singularities of Born's Electrodynamics. G. Darrieus. *Comptes Rendus*, 204. *pp*. 1923–1925, *June* 28, 1937.—A simple transformation leads to the conception of the field in Born's theory comprising not a point, but the exterior of a sphere which can be represented as the apparent contour of a hypersurface of three dimensions in four-dimensional space. N. M. B.

3922. Light Signals on Moving Bodies as Measured by Transported Rods and Clocks. H. E. Ives. *J.O.S.A.* 27. *pp*. 263–273, *July*, 1937.—The discussion previously given [see Abstract 2971 (1937)] is extended to the observation by means of moving clocks and measures of light signals travelling in a fixed ether. Provided the rods and clocks move at the same measured speed the results may be expressed entirely in terms of the observed quantities. The impossibility of determining simultaneity is related to the indeterminacy used in other branches of physics. Stellar aberration provides the evidence for the uncompensated difference (aberration angle) in the character of light entering and leaving an interferometer referred to in the previous paper. H. G. C.

See also Abstracts 3939, 4006.

SOLUTION.

3923. Interionic Attraction Theory of Electrolytes. D. A. MacInnes. *Science*, 86. *pp*. 23–29, *July* 9, 1937.—A short survey of experiments carried out at the Rockefeller Institute U.S.A. in connection with the above theory. The present theory supposes that a strong electrolyte consists entirely of ions and is based on Debye-Hückel and Onsager modifications of Arrhenius's original theory introducing the conceptions of " electrophoretic effect " and " time of relaxation effect." This theory is supported by measurements of concentration cells, conductances and transference numbers, the latter by the " method of moving boundaries." It is in this region of strong electrolytes that Arrhenius's theory is the least successful. It is shown that for weak electrolytes the assumption of complete dissociation is inadequate and that the success of Ostwald's dilution law based on Arrhenius's original theory rests largely on the compensation of two errors. It is also shown that the interionic attraction theory is as useful in interpreting the experimental data for weak electrolytes as for strong ones. R. L.

3924. Henri Coefficient for Gases Dissolved in Liquids Exerting High Vapour Pressures. I. R. Kritschewsky. *Acta Physicochimica,* 6. 6. *pp.* 859–864, 1937. *In German.*—A simple thermodynamical equation is derived which applies to two-phase equilibrium in a binary system and gives the limiting ratio of the concentration of the gas dissolved in a liquid phase to the concentration in the vapour phase as these concentrations approach zero. In addition to the molar volumes of the pure solvent in the liquid and vapour states it is necessary to know only the dependence of the total pressure upon the concentration of the gas dissolved in the liquid phase. The equation is applicable to the calculation of the Henri coefficients of gases dissolved in liquids under conditions of temperature such that the vapour pressures are high. A thermodynamical equation is derived for the determination of the difference of the partial molar volumes of the dissolved gas in the liquid and vapour phases as the concentrations approach zero. For this calculation it is necessary also to know the compressibility of the pure solvent in the liquid and vapour states. L. A. W.

3925. Theoretical Formula for the Solubility of Hydrogen in Palladium. J. R. Lacher. *Roy. Soc., Proc.* 161*A. pp.* 525–545, *Aug.* 20, 1937.—A theoretical formula for the solubility of He in Pd is developed by assuming there are a definite number of holes in the metal for the H_2 to go into and that the heat of absorption increases as the number of holes filled increases. The formula gives a critical temperature above which only one solid phase can exist, and below which two solid phases can be in equilibrium with one another. The rate of increase of the heat of absorption with the amount of dissolved H_2 is directly proportional to the fraction of the holes filled, for a homogeneous phase. At low temperatures, the heat of absorption results almost entirely from a phase change. The heats of absorption in a homogeneous phase and in the two-phase region are correlated simply with the critical temperature. A study of the pressure-composition isotherms leads one to an understanding of the "hysteresis" phenomena shown by the system. The equations developed exclude, however, the existence of definite palladium hydrides. The difference in the solubility of H_2 and D_2 is shown to be due to the differences in the masses of the isotopes. AUTHOR.

See also Abstracts 3817, 3818, 3854, 4008, 4112.

SURFACE TENSION AND COHESION.

3926. Built-up Films of Barium Stearate and their Optical Properties. Katharine B. Blodgett and I. Langmuir. *Phys. Rev.* 51. *pp.* 964–982, *June* 1, 1937.—Barium-copper stearate films containing up to 3001 layers have been prepared by the method previously described [see Abstract 3331 (1935)]. Their mechanical behaviour (rigidity, cracking, slipping from support, etc.) is very sensitive to Cu content of the solutions used. The films are uniaxial crystals with optic axis perpendicular to their area; their thickness is 24·40Å per barium stearate layer and their refractive indices to sodium light are $n_1 = n_2 = 1{\cdot}491$, $n_3 = 1{\cdot}551$ (figure given in previous paper being in error). Films formed at pH $<$ 7·0 are composed of a mixture of neutral stearate and stearic acid; the latter can be dissolved out in benzene leaving birefringent skeleton films of much lower refractive indices though of the same thicknesses as the original films. Equations are given for the refraction of the ordinary ray, the intensity of the rays reflected from the upper surface and from the film-solid boundary, the phase change at the boundaries, Brewster's angle and other special properties of such birefringent films. L. V. C.

3927. Influence of a Thin Film of Oil on the Movement of Waves. R. Mérigoux. *Comptes Rendus,* 205. *pp.* 115–117, *July* 12, 1937. If a monomolecular film of oil is adsorbed on the surface of water, the surface in contact with the oil is flat but [see Abstract 4039 (1936)], at the edges, Poncelet's ripples appear. It is shown mathematically that, for pressures varying from point to point, on the surface, no stable ripples can exist. Experimentally it is seen that a disturbing element, *e.g.* wind, has less purchase on the oily surface than on water, and the velocity gradient between the oil and the water is so great that, the energy instead of accumulating in the surface as ripples, tends to penetrate more deeply into the water and be dissipated there. Thus, it is by friction with the water and not by lubrication that the waves are flattened. H. M. B.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 3946.

VISCOSITY, FRICTION AND LUBRICATION.

3928. Kinematic Viscosity Expressed in Saybolt Seconds and C.G.S. Units. S. Erk and H. Eck. *Phys. Zeits.* 38. *pp.* 469–476, *July* 15, 1937. *From the Reichsanstalt.*—Formulæ and tables for the conversion of kinematic viscosity in Saybolt seconds into C.G.S. units (Stokes) are compared and tested. The equation $\nu = (S/29\cdot0)\,6\cdot163^{\{1-(29\cdot0/s)^3\}}$, or $\nu = 0\cdot212_5$ S when S > 400 sec., is put forward as most probably the best relation. It is shown both practically and theoretically that to the accuracy associated with the measurements, the formula does not require modification with change of temperature. The velocity distribution in the Saybolt viscometer is not parabolic for small outflow times, and therefore Poiseuille's law is not applicable. P. H. B.

3929. Flow of Gaseous Mixtures through Capillaries. Parts II and III. H. Adzumi. *Chem. Soc. Japan, Bull.* 12. *pp.* 285–303, *June,* 1937.—In Part II measurements on H_2, C_2H_2, C_3H_6, $H_2 - C_2H_2$, and $H_2 - C_3H_6$ show that the rates of molecular flow of simple gases are expressed satisfactorily by Knudsen's formula, and, in the case of mixtures, are additive of the components. Measurements of changes of compositions of the mixtures after flowing through the capillary at low pressures show also the validity of the additive law. In Part III measurements are reported for the flow of the following gases and mixtures: H_2, C_2H_2, C_3H_6, $H_2 - C_2H_2$, $H_2 - C_3H_6$, C_6H_6, CCl_4, $CHCl_3$, $(C_2H_5)_2O$, $C_6H_6 - CCl_4$, $CCl_4 - CHCl_3$, $(C_2H_5)_2O - CHCl_3$. The flow K is a function of the mean pressure p, and the K-p curve passes through a minimum. For simple gases $K = ap + \gamma b$, where γ is a coefficient varying between 0·9 and 1·0 at high and low pressures, respectively. The flow of mixtures is expressed by an analogous formula. The viscosities of $C_6H_6 - CCl_4$, $CCl_4 - CHCl_3$, and $(C_2H_5)_2O - CHCl_3$ mixtures are calculated from the flow. The mixture $CCl_4 - CHCl_3$ shows a maximum at about 50 % $CHCl_3$, and the viscosity curves of the other two are nearly straight. [For Part I see Abstract 3432 (1937).] N. M. B.

3930. Gas Flow in Narrow Channels. R. E. H. Rasmussen. *Ann. d. Physik*, 29. 8. *pp.* 665–697, *Aug.*, 1937.—Measurements are made, using air, H_2, O_2, CO_2 and A, of the gas quantity, T, which flows per sec. per unit pressure difference at mean pressures ranging from 0·00003 to 40 cm. Hg, through narrow channels of four distinct types. At higher pressures T increases linearly with the mean gas pressure, in accordance with the theory for laminar flow. As the pressure is reduced, T decreases to a minimum value, which occurs when the channel width is comparable with the mean free path, $T_{min.}$ being approximately the value given by Knudsen's formula for molecular flow. On further reduction of pressure, T increases to a constant value T_0, in fair agreement with Clausing's formula. For any one channel $TM^{\frac{1}{2}}$ is approximately the same function of the mean free path for all gases. R. W. P.

***3931. A.S.T.M. Penetration Equipment for Estimating the Viscosities of Materials of High Consistency. E. O. Rhodes and E. W. Volkmann.** *J. of Applied Physics*, 8. *pp.* 495–496, *July*, 1937.—In a recent publication [see Abstract 1496 (1937)] Thelen described experiments in which the standard penetrometer was used to determine the flow-shear diagrams for a number of asphalts. On the basis of these diagrams Thelen calculated viscosities which are of different magnitude from those expected from Saal's formula. In the present paper certain fallacies in Thelen's deductions are pointed out. A new method for analysing Thelen's experimental results is shown which makes it possible to calculate absolute viscosities from penetration readings for a series of successive time intervals. The method is based upon the determination of viscosity by axial displacement of concentric vertical cylinders. Since the conditions under which viscosity can be determined by axial displacement are only approximated in the penetration test the new method cannot be expected to have a high degree of accuracy. Nevertheless from successive penetration readings on a coal tar pitch (penetration 100 g, 5 sec. at 25° C.) an average viscosity of 383,000 poises was calculated which closely agrees with the value of 380,000 determined by a capillary rise viscometer. The viscosity as calculated from the initial penetration reading by the Saal formula was 355,000 poises. AUTHORS.

3932. Viscosity of Hydrocarbon Solutions: Methane-Propane-Crystal Oil System. B. H. Sage, B. N. Inman and W. N. Lacey. *Indust. & Engin. Chem.* 29. *pp.* 888–892, *Aug.*, 1937.—The effect of pressure upon the viscosity of the liquid phase of 18 mixtures of methane, propane, and crystal oil was determined at 100° F. The work included measurements at bubble point and throughout the condensed liquid region at pressures up to 3000 lb./in^2. The results are presented in tabular form, and several diagrams illustrating the behaviour of the system are included. AUTHORS.

3933. Viscosity of Lubricants under Pressure. Part I. Fatty Oils. M. D. Hersey and R. F. Hopkins. *J. of Applied Physics*, 8. *pp.* 560–566, *Aug.*, 1937.—In this paper the principal results of experiments on the viscosity of lubricating oils under high pressure, other than mineral oils, are reduced to the same units and collected for comparison. The investigations reviewed are those of the American Society of Mechanical Engineers; J. H. Hyde at the National Physical Laboratory of Great Britain; S. Kiesskalt at the Technische Hochschule, Karlsruhe, Germany; and Y. Suge at the Institute of Physical and Chemical Research, Tokyo, Japan. Viscosity-pressure-temperature data are given for 11 different oils. AUTHORS.

3934. Internal Friction in Solids. Part I. Theory of Internal Friction in Reeds. C. Zener. *Phys. Rev.* **52.** *pp.* 230–235, *Aug.* 1, 1937.—In a vibrating reed opposite sides have dilations of opposite signs. Thus when one side is heated the other is cooled. At low frequencies the vibrations are isothermal. At high frequencies they are adiabatic. At intermediate frequencies they are of a hybrid type accompanied by internal friction. In this paper this internal friction is calculated solely from thermodynamical considerations. It is predicted that the internal friction associated with this hybrid type of vibration is of a larger order of magnitude than that due to all other causes. AUTHOR.

***3935. Viscometer with Suspended Level. L. Ubbelohde.** *Inst. Petroleum Technologists, J.* **23.** *pp.* 427–451, *July,* 1937.—Describes developments in the construction of the viscometer previously described [see Abstract 3392 (1933)]. The new instrument possesses a spherical level which eliminates correction on account of surface tension of the liquid tested. Furthermore, the factor m in the Hagenbach-Couette correction for kinetic energy has the same value 1·12 for a viscometer with suspended level as for all other capillary viscometers; a new correction table is now given for kinetic energy based on this factor. Full experimental and descriptive details are included. To make the dimensions of the apparatus, especially the capillary, accurate enough, it has been necessary to manufacture the capillaries with an accuracy of at least 0·01 mm. H. H. Ho.

See also Abstracts 3882, 3893.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3936. Spectrograph of Helsingfors Observatory. G. Järnefelt.** *Soc. Scien. Fennica, Comm. Phys.-Math.* 9. 5. [33 *pp.*], 1937. *In German.*—The construction of the instrument and its use in conjunction with a refractor are described. It may be fitted with 1 or 3 prisms, and with camera lenses of 21, 35, or 55 cm. focal length. The thermostat arrangements are dealt with fully. The adjustments discussed include setting the prism in minimum deviation for λ4308, and accurate focusing of the instrument as a whole. The author examines the curvature of the spectrum lines at various wave-lengths; the quality of the optical train employed; the effect of temperature changes; and the effects of flexure in the instrument when the telescope is swung around. Displacements associated with the latter may consist of lateral movement of the whole spectrum or of shifts perpendicular to the lines. Values of the displacements due to various causes are shown as functions of H.A. and dec. The degree of accuracy attainable in radial velocity work with the instrument is fully discussed. A numerical example illustrates the least-squares process of reduction of the plates by means of a Cornu-Hartmann formula. A. Hu.

***3937. Pendulum-Controlled Telescope Drive. C. H. Tindal.** *Rev. Sci. Instruments*, 8. *pp.* 251–252, *July*, 1937.—A modification of the Gerrish drive which utilises 110-V a.c. for the pendulum-control circuit (in addition to the motor). The ordinary commercial a.c. power does not remain sufficiently constant for driving even short focus telescopes so as to prevent elongated star images. The motor should be run about 20 % below rated speed, so that it always has an over-speed tendency, making it more easily controlled. The author has used this form for six months, and it has given satisfaction. A. S. D. M.

COMETS AND METEORS.

3938. Second Catalogue of Harvard Observatory Meteor Photographs. Dorrit Hoffleit. *Harvard Coll. Obs., Ann.* 82. 8. *pp.* 179–195, 1937.

COSMOGONY.

3939. Dynamics in Milne's Model Universe. S. Simasaki. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 566–572, *June*, 1937. *In English.*—A Lagrangian function is found whose variations give the equations of motion of the accelerated particles in Milne's kinematical relativity.
G. C. McV.

3940. Static Universe and Nebular Red Shift. S. Sambursky. *Phys. Rev.* 52. *pp.* 335–338, *Aug.* 15, 1937.—Hubble's recent nebular counts have brought the question of a static universe into the forefront. The red shift of the nebulæ in a static universe can be explained if instead of postulating a growing world radius we proceed on the assumption of a shrinkage of the universal lengths of atomic physics, this being equivalent to a decrease with time of the quantum of action. A new quantity, *h*, is thereby defined and, if introduced into the Dirac equation of the electron, leads to gravitation. The consequences of this connection and other features of the theory are discussed and compared with experience. AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3941. Dynamics of a Stellar System. B. Lindblad. *Roy. Astron. Soc., M.N.* 97, *pp.* 642–645, *June*, 1937.—The author disputes the contention of Clark [see Abstract 1978 (1937)] that the methods of Eddington and Jeans for finding the frequency function of the spatio-velocity distribution in a stellar system are not equivalent when the systems are everywhere ellipsoidal. He recalculates the relevant quantities and finds agreement between the two methods. G. C.McV.

See also Abstract 3944.

NEBULÆ

3942. Selective Absorption in the Aquila Region of the Milky Way. C. E. Smith. *Lick Observat. Bull. No.* 484. *pp.* 39–51, 1937.—A study of relationship between colour excess and distance in the Milky Way surrounding the great rift in Aquila. A plate is given. 14 circular areas (6 in the rift, and 4 to the north and south of it) are used, wherein for 423 stars, the magnitudes, spectral classes, colour indices and excesses are determined. In each field the colour excess is plotted as a function of the distance modulus, the excess increasing with distance and more rapidly as the galactic latitude decreases. In the rift the coefficient of selective absorption rises to 1·4 magnitudes per 1000 parsecs, indicating dense local clouds extending from about 250 to 1000 parsecs in the galactic plane, but it has not the same value perpendicular to the plane as in the north and south branches. Supergiant stars can be distinguished from ordinary giants by their colour excess in the Milky Way regions where there is large selective absorption. A. S. D. M.

3943. Galactic Structure. Milky Way from Aquila to Cygnus. F. D. Miller. *Nat. Acad. Sci., Proc.* 23. *pp.* 405–409, *July*, 1937.—A study of the stellar density functions, distance and total photographic absorption of the discrete dark nebulæ at the northern end of the great Rift. This involves a homogeneous magnitude system over several hundred square degrees; this has been obtained with probable errors not greater than $\pm 0^{\mathrm{m}}.1$. The characteristic feature of this region's density distribution is the extension of nearly unit density to distances of 1000 parsecs in the galactic plane, and to smaller distances in higher latitudes. The present material seems to show that no distinct star-cloud (to be identified with the bright "Cygnus Cloud") is to be found within 2000 parsecs of the sun. The observed limits of the bright area are determined by the distribution of dark nebulæ at distances not less than 500 parsecs. Star counts near the North America nebula suggest that the Cygnus Cloud space density function is characteristic of longitudes 30°–55°.

A. S. D. M.

See also Abstract 3940.

PLANETS.

3944. Advance of Nodes and Perihelia of Planetary Orbits. V. Kourganoff. *Bull. Astronomique*, 10. 2. *pp.* 109–120, 1937.—The author examines Chazy's approximations for the advance of nodes and perihelia of perturbed planetary orbits [see Abstract 125 (1937)] in the light of Le Verrier's observations on the solar system. After making due allowance for a difference of zero point between theory and observation, he finds the theoretical results verified for orbits of great, but not for those of small eccentricity. The discrepancies are traced to a discontinuity in the approximation arising from an unwarranted assumption that the orbit of the perturbing planet is circular. The errors are shown to be greatly reduced by allowing for the orbit's eccentricity. A. Hu.

3945. Physical State of Jupiter's Atmosphere. B. M. Peek. *Roy. Astron. Soc., M.N.* 97. *pp.* 574–582, *June,* 1937.—The relations between depth, pressure, temperature and density in Jupiter's atmosphere are investigated. Three models are considered :—(1) The adiabatic. (2) The isothermal. (3) A compromise, in which an empirical relation is assumed between the depth and the lapse rate. The results, for an atmosphere of CH_4, are plotted in the case of the first two models ; for the last, three curves are given, showing the relations for methane in the pure state, and with the addition of two different proportions of H_2. It is found that the third model admits of greater depths than either of the first two, but that even in this case the great densities that are rapidly attained suggest that the atmosphere must lose its familiar characteristics below a depth of about 25 km. AUTHOR.

3946. Periodicity in Irregularity of Earth's Rotation. N. Stoyko. *Comptes Rendus,* 205. *pp.* 79–81, *July* 5, 1937.—The author now includes the Washington pendulum clock with that of Paris, and the quartz clocks of Charlottenburg. A table is given of the departures from the means of the monthly clock rates for each month and year from 1934 Jan. to 1937 April. An annual periodicity is evident and must be due to irregular rotation ; the speed of rotation increases from July to October diminishing in the other months. The Chandler period of 435 days does not appear. This periodic variation can be explained by a change in the earth's radius of 4 cm. or in the crust (down to 100 km.) of 2 m. ; an efficient cause for this may be found in the polar cap freezing and melting, or in the cycle of vegetation. [See also Abstracts 4061 (1936) and 2997 (1937).] A. S. D. M.

3947. Orbit of Minor Planet (122) Gerda. A. A. Ivanov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 6–7. *pp.* 301–305, 1937. *In French.*

STARS.

3948. Orbits of the Spectroscopic Components of Boss 2142. W. E. Harper. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 18. *pp.* 305–309, 1937.—47 single prism spectrograms of this spectroscopic binary, showing both component spectra, were used in the orbital determination yielding the following elements :—$P = 18.772$ days, $e = 0{\cdot}174$, $\omega_1 = 208^\circ{\cdot}1$, $\gamma = +\,8{\cdot}3$ km./sec., $K_1 = 64{\cdot}6$ km./sec., $K_2 = 71{\cdot}5$ km./sec., $T =$ J.D. 2,422,015·449. The component spectral lines are more or less blended most of the time, hence the measures do not lend themselves to high precision in the orbit. AUTHOR.

3949. Orbit of OΣ 79. L. S. T. Symms. *Roy. Astron. Soc., M.N.* 97. *pp.* 635–641, *June,* 1937.

3950. Method of Determining Stellar Rotation. J. A. Carroll. *Nature,* 140. *p.* 162, *July* 24, 1937. *Abstract of paper read before the Astron. Soc., Newcastle-upon-Tyne, March* 11, 1937.

3951. Regional Study of Interstellar Sodium. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 569. *Astrophys. J.* 85. *pp.* 28–43, *July,* 1937.—A comparison of intensities and displacements of detached Na lines in star spectra in various galactic longitudes. The distance-intensity relation is investigated in 23 small and 7 large stellar groups along the Milky Way. In the small groups, the distant stars exhibit little increase in luminosity; in the large regions chosen with respect to the null points of galactic rotation it is shown that standard galactic rotation has little influence on the observed intensities of detached D lines, and Na vapour does not increase obviously towards the galactic centre. In the 14 regions taken the influence of galactic rotation is plainly seen in the observed motions of individual stars, but some other phenomenon must also be active in producing the observed intensities. [See following Abstract.] A. S. D. M.

3952. Analysis of Intensities of Interstellar D Lines. O. C. Wilson and P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 570. *Astrophys J.* 85. *pp.* 44–69, *July,* 1937.—The intensities and displacements of interstellar Na lines [see preceding Abstract] can be explained by assuming that Na occurs in large clouds of average linear dimensions of about 700 parsecs. These take part in galactic rotation, and have their own velocity distributions which may be up to 15 or 20 km./sec. No exact value can be given to their temperatures, but the upper limit is about 44,000°; the average number of neutral Na atoms per cm^3. is about 3×10^{-9} and density about 10^{-31} gm./cm^3. It is difficult to reconcile the low ratio (1·2) of D_2 to D_1 with the almost linear increase of intensity to length of light path, and therefore the properties of Na must vary through space. Galactic motions do not explain this, and the authors suggest discrete Na clouds which perhaps are the counterparts of the observed dust clouds along the Milky Way. A. S. D. M.

3953. Modes of Radial Oscillation in Stellar Masses. T. E. Sterne. *Roy. Astron. Soc., M.N.* 97. *pp.* 582–593, *June,* 1937.—The author investigates mathematically the small, radial, spherically symmetrical, adiabatic oscillations in stellar masses of different density distributions. In each case there is an infinite set of possible modes, each a periodic radial oscillation, differing from one another in their disposition of nodal surfaces and in their generally incommensurable periods. The general differential equation for small oscillations is first derived from the equation of motion. Then expressions are obtained for the periods of the modes in spheres in which (1) the density is uniform, (2) the density varies inversely as the square of the distance to the centre, and (3) nearly all the mass is contained in a particle at the centre. The conditions of stability and the extent of radiative damping are discussed for each of these models. The periods of the first few modes of the models are compared with the values obtained by Eddington and Edgar, by numerical integration, for an Emden polytrope of index 3. A. Hu.

3954. Internal Constitution of Eclipsing Binaries. Z. Kopal. *Roy. Astron. Soc., M.N.* 97. *pp.* 646–655, *June,* 1937.—The author examines to what extent stellar models of eclipsing binaries can be brought into agreement with observation by allowing for rotation, for variations of molecular weight and for changes in the value of $k\eta$. G. C. McV.

3955. Line Contours in Nova Herculis, First Phase. E. G. Williams. *Roy. Astron. Soc., M.N.* 97. *pp.* 612–635, *June,* 1937.—The contours of absorption and emission bands of H, Fe II, Mg II, and Si II are measured for 18 spectrograms secured on each of the first 8 days following the outburst. With the help of the Greenwich energy distribution measurements, the intensities of the emission bands are converted into true relative values. The variations with time are with certain exceptions similar to those in the spectral sequence. The Balmer decrement in emission is found to be considerably less steep than theory indicates for either electron capture or polychromatic radiative equilibrium. In absorption the Balmer lines decrease steadily in strength towards the series limit. The mean contour of the H and Fe emission lines is well represented by an error curve. It is considered that the appearance of the spectra, in particular the shapes of the absorption lines, is more favourable to the hypothesis of continuous ejection than to that of a discrete expanding shell. A. Hu.

3956. Observations of Novæ, 1936-1937. W. H. Steavenson. *Roy. Astron. Soc., M.N.* 97. *pp.* 655–660, *June*, 1937.—

See also Abstract 3941.

SUN.

3957. Height of the Chromosphere in 1936 and Course of the Solar Cycle. G. Abetti. *Accad. Lincei, Atti,* 25. *pp.* 253–254, *March* 21, 1937.—The results of observations of the height of the chromosphere carried out at Arcetri and Prague during 1936, measuring the height from the line $H\alpha$ inverted, are collected and given in a table. The accord between Arcetri and Prague is very good as in the preceding year. The mean Arcetri-Prague for 1936 compared with 1935 gives $1936 - 1935 = +0''\cdot30$. J. J. S.

3958. Spectrum of Solar Corona at Total Eclipse in 1936. Part I. Coronal Lines. T. Tanaka, Z. Koana, and M. Kondô. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 693–711, *July*, 1937. *In English.*—2·4 ± 0·1 km./sec. was obtained by Doppler effect as the rotational speed of the lower part of the corona relative to the earth. 15 recorded coronal lines were perceived with some certainty and their wave-lengths were determined in comparison with Fe arc standard lines with some accuracy. Among the coronal lines reported formerly, three are doubtful, two are somewhat doubtful, while one shows no trace. Five unrecorded lines are proposed as new coronal lines with some certainty, while one of them, 5300·0 Å, is found in Dyson's spectrogram, one 4623·0 Å, in some Novæ and one, 5306·3 Å, in both of them. 16 absorption lines were perceived in blue and violet regions. AUTHORS.

3959. Cores of Certain Fraunhofer Lines. R. O. Redman. *Roy. Astron. Soc., M.N.* 97. *pp.* 552–574, *June*, 1937.—The author seeks the most accurate measurement of the central parts of a few well known lines in the region, $\lambda\lambda$ 4000–4500, using the same technique as before [see Abstract 4911 (1935)], but tracking down all conceivable sources of error. Those, due to scattered light and to distortion, are eliminated by the use of the new monochromator and by the use of emission Krypton lines; he conceives that the probable errors of the central intensities do not exceed 0·7%. His suggestion of deviations of observed "matter in bulk" and of "separate motions of individual atoms" is corroborated by Allen's "large scale and small scale disturbances" [see Abstract 2478 (1937)]; the average line-of-sight velocities obtained by the author and by Allen are of the order of 1·5 to 1 km./sec., and 1·8 to 1·5 km./sec., respectively. A. S. D. M.

See also Abstracts 3974, 3989, 4106, 4218, 4219.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

3960. Comparison of Radioactivity of Rocks. E. Rothé and T. Kopcewicz. *Comptes Rendus,* 205. *pp.* 165–166, *July* 12, 1937.—An arrangement is described for determining the radioactivity of powdered rocks by means of a Geiger-Müller counter protected from all parasitic radiation by Pb screens. Thus determined the ratio of the radioactivities of granite from Brifosse and of rhyolite from Rosskopf is 1·48. Comparison with standard amounts of radiferous $BaCl_2$ shows the actual content of radioactive matter in the granite and rhyolite to be equivalent to $32 \cdot 9 \times 10^{-12}$ and $22 \cdot 1 \times 10^{-12}$ gm. Ra respectively. [See Abstract 3471 1937)]. C. A. S.

HYDROSPHERE, PHYSICS OF THE

3961. Temperature of Surface Waters of the Irish Sea. J. Proudman, H. Mabel Lewis and A. L. Dennis. *Roy. Soc., Phil. Trans.* 236*A*. *pp.* 261–302, *June* 26, 1937.—This paper gives a statistical treatment of most of the observations of the temperature of the surface waters of the Irish Sea which were taken between the years 1900 and 1934. Its objects are :—1. To calculate grand mean values of the characteristics of the sea-water temperature at as many stations as is practicable. 2. To put on record the chief features of the sea-water temperatures observed at Port Erin Bay during the period from Jan. 1903, to Dec. 1931. 3. To investigate the degree of correlation between the sea-water temperature at any place in the Irish Sea and that at Port Erin Bay. 4. To construct charts of grand mean values of the characteristics of sea-water temperature, inferred for the period from Jan. 1903, to Dec. 1931. 5. To investigate the degree of correlation between the sea-water temperature at several stations and a number of meteorological variables. The chief results are given in 14 tables, and the paper is illustrated by five charts of isothermal lines. AUTHORS.

3962. Measurement of Submarine Daylight. H. H. Poole. *Nature,* 140. *pp.* 50–52, *July* 10, 1937.—The Se photo-cell is regarded as most suitable for this purpose. The methods of using it by different observers are described. Observation of the variation in the surface light is made by a second cell exposed under similar conditions. The difficulty of expressing the submarine illumination in definite units is discussed, and also the standardisation of cells. The results of observations in the Sargasso Sea show low absorption in that region. Coastal waters always show higher absorption. The variation of opacity with depth is considered. A standardised method for routine measurements is desirable but the author considers that further experience with available cells and modes of measurement is required before any definite form of apparatus and method is decided upon. A. E. M. G.

3963. Relation Between Rainfall and Stream Flow. Part III. R. T. Zoch. *Monthly Weather Rev.* 65. *pp.* 135–147, *April,* 1937.—This article which is intimately connected with the preceding parts [see Abstract 4596 (1935)], deals with evaporation after rain stops and its effect on stream flow. In the first portion of the article certain definitions are given and certain assumptions made explained. The author then proceeds in the second portion to consider the run-off, discharge from a rectangular area and discharge from any drainage area corrected in each case for evaporation. Evaporation has been considered (1) when independent of the amount of water remaining in the soil; (2) when so dependent. Equations which were established in the previous work are here generalised. The effect of evaporation on the time of maximum discharge and of flood crest are considered. The latter is found to be advanced by evaporation. The author next considers the possibility of diurnal variation of the rate of run-off. Here observation shows no noticeable diurnal variation at the outlet of a drainage area of moderate size. The paper closes with a consideration of three hygrographs. These represent discharge with and without evaporation considered. Each case is shown by diagram. A. E. M. G.

LAND, PHYSICS OF THE.

3964. Subsidence and Ground Movement in Coal Mines. H. P. Greenwald. *J. of Applied Physics,* 8. *pp.* 462–469, *July,* 1937.—Subsidence depends upon the structure of the beds, the physical properties of the coal and other rocks, the lay of the rocks, and the nature of the supports, as well as the method of working the seams. Mechanical properties of coal have been studied, but caution is necessary in applying them to the problem. Tests on small specimens give higher values for the strength than those on larger specimens, for in larger specimens failure is due to fracture at the "cleat," or system of vertical jointing. This is also borne out by observations of coal pillars in place, where in general the larger the pillar the lower is the compressive strength at failure. The rocks of the floor and roof of a seam may vary from plastic materials like underclay, which flow under load, to strong and elastic materials such as sandstone. The mechanical properties of overlying rocks may be the major factor in determining the movement. The U.S. Bureau of Mines has devised a convergence recorder for determining the relative movements of roof and floor. This is described. It is found that at first the convergence is small, and then proceeds very rapidly to the point of fracture. This shows that laboratory data must be used with great caution, as the element of time greatly influences the behaviour of the materials under load. There are many theories of stress distribution in undermined strata. The theory of arch stresses needs careful review in application to actual cases, as it obviously implies abutments which may or may not be present. A more recent attack on the problem considers strata subsiding over mine workings as bent plates. W. A. R.

3965. Thermal Diffusivity of a Disperse Solid. A. Courtener and A. Chudnovskij. *Techn. Phys., U.S.S.R.* 4. 3. *pp.* 252–255, 1937. *In French.*—A method is described for the determination of the variation of the thermal diffusivity of a disperse moist medium such as soil, which is based on the measurement of the temperature at a fixed distance from a linear isothermal heat source immersed in the medium. Measurements can be made under varying conditions, and the effect of changes in moisture content on the thermal diffusivity can be easily determined. R. W. P.

3966. Quantitative Study of Mountain Building on an Unsymmetrical Earth. R. Gunn. *Frank. Inst., J.* 224. *pp.* 19–53, *July,* 1937.—The principle of isotatic equilibrium of the earth's crust is discussed and restated in a useful form which takes account of superposed vertical stresses. A quantitative study of the deformations produced in the earth's elastic crust by tangential compressional forces is made. The calculated physical properties of a suboceanic compressional downfold agree well with those observed in certain long and narrow ocean deeps. The properties of a downfault in continental regions are similarly deduced and it is shown that such a deformation evolves ultimately into a great sedimentary prism or geosyncline. The processes which fold and ultimately uplift the prism to form a mountain chain are quantitatively considered. A quantitative theory of mountain building leads to a law of mountain heights in good agreement with observation. The considered mechanisms are consistent with the principle of isostasy and with the author's earlier estimates concerning the concentration of stresses at the boundaries of the great continents [see Abstract 5060 (1936)]. It is concluded that the circum-Pacific mountain chains could only have been generated on an unsymmetrical earth produced probably by a fission process much like that suggested in the author's binary star theory of the origin of the solar system [see Abstract 4170 (1932)]. AUTHOR.

See also Abstracts 3960, 3983.

METEOROLOGY.

3967. Distribution of Atmospheric Ozone. O. R. Wulf and Lola S. Deming. *Terr. Mag.* 42. *pp.* 195–202, *June*, 1937.—This paper continues previous work [see Abstract 1579 (1937)] on atmospheric O_3. The authors first deal with three forms of the O_3 absorption curve near the 2000 Å wave-length. The calculated distribution of O_3 with height for the three cases is given in tabular form and is also represented by diagram. As atmospheric circulation may alter the distribution of O_3 it is necessary to estimate the values of the rates at which the steady state is maintained at various heights. This the authors do and give calculated numerical values of these rates for different heights. In conclusion they further point out that assuming photo-chemical origin of O_3 the existing O_3 may be at least roughly in equilibrium with solar radiation at all heights, or may be carried into regions protected from solar radiation, the fraction in equilibrium with solar radiation being small. A. E. M. G.

3968. Chemical Composition of Atmosphere. F. A. Paneth. *Roy. Meteorolog. Soc., J.* 63. *pp.* 433–438, *July*, 1937.—In a previous contribution [see Abstract 2007 (1937)] the author gave a table showing the composition of the atmosphere and stated that this was valid throughout the troposphere. In the present paper he reviews the most recently determined percentage values of the atmospheric gases at the surface of the earth. These are set out in tabular form. Thereafter he proceeds to discuss the results of observations on the composition at different heights. Special attention is given to the hydrogen content. Reasons for apparent excess of various gases between 9 and 17 km. height are stated. It is finally concluded that the round figures given in this paper are independent of height throughout the troposphere and in the first kilometres of the stratosphere. Investigations are in progress for the detection of small local variations in the composition of ground level air. A. E M. G..

3969. Thermal Structure of Stratosphere up to 30 km. J. Jaumotte. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 403–422, 1937. *Julius Maurer Festschrift. In French*—Observations carried out during 1934–36 by means of a Jaumotte Meteorograph are dealt with. The results indicate an inversion of temperature commencing in spring and continuing until autumn, occurring sharply at a height varying between 16 and 26 km.

The level of the inversion depends upon the origin of the air and amounts to between 1° and 2° C. per km. It appears every year but the time of commencement appears to depend on the commencement of diffusion, ozone content and electrical conductivity. This suggests to the author that this singular level constitutes the base of the real stratosphere. The ozone content is regarded as the prime cause of the inversion without at the same time a direct relation existing between the two. Diagrams illustrate the results of a number of soundings. A. E. M. G.

3970. Absorption of Radiation by Water Vapour. H. Wexler. *Monthly Weather Rev.* 65. *pp.* 102–104, *March*, 1937.—In a previous paper [see Abstract 4603 (1936)] two models A and B were discussed. In this note further evidence is presented showing that model B accounts for atmospheric absorption as actually observed except under conditions of low pressure and temperature. A discussion is given of some simultaneous observations of outgoing radiation and aeroplane soundings made at Fairbanks, Alaska, during last winter. An instance of the magnitude of ground inversion observed in one of the ascents is shown diagrammatically. The equilibrium surface temperature calculated in accordance with model B is in agreement with observation. The author also deals with the loss of energy by way of the emission layer situated in the upper atmosphere below the −50° C. isotherm, again making use of the radiation properties that follow from model B, and obtaining results in agreement with observation. It is concluded therefore that model B is more satisfactory than model A for computations which involve atmospheric radiation. A. E. M. G.

***3971. Wind in Britain. P. C. Bartrum.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 352–354, *July*, 1937.—In this article which arises out of a paper by E. Gold [see Abstract 2631 (1936)] the author deals with a device for recording high winds by a Dines anemometer at Bermuda. A weight, W_1, is added to the float and a calculation is given showing the relation between the height of the float before and after the addition of the weight. A comparison between this and the corresponding value obtained by Gold reveals a slight discrepancy which is negligible except for large values of W_1. As, however, air bubbles from under the float before very high winds are recorded, the "weight" method is regarded as of no value, and the author after suggesting as an alternative the turning off of one of the stopcocks, asks for other suggestions. [See following Abstract.] A. E. M. G.

***3972. Modifications of Dines Anemometer. E. Gold.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 373–380 ; *Disc.*, 380–382, *July*, 1937.—The author, after explaining the origin of the discrepancy referred to [see preceding Abstract], proceeds to compute for the standard anemometer the maximum velocity which may be recorded before air begins to bubble from inside to outside of the anemometer float. Three cases are dealt with : (1) float loaded so that it remains at zero. This gives a maximum of 178 m.p.h. ; (2) float loaded so that pen reaches 100 m.p.h. level on standard chart giving a maximum of 137 m.p.h. ; (3) float unloaded giving thereby a maximum of 122·5 m.p.h. The investigation reveals that the standard instrument must be modified to record on a linear scale velocities greater than 122·5 m.p.h. Methods of accomplishing this are examined and numerical dimensions of the float are given to enable velocities up to 200 m.p.h. to be recorded. In the subsequent discussion various modifications of the existing instrument are dealt with. A. E. M. G.

3973. Monsoon Theory. W. Shoulejkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 15. 6–7. *pp.* 319–322, 1937. *In English.*—Following the statement that monsoon air currents arising in winter over warm sea and cold continent can be determined analytically, expressions are given for the radial component of air velocity, gradient of atmospheric pressure and mean temperature of active air stratum; also for amount of heat transferred by air currents. Values of vertical temperature in the coastal zone and of maximum radial velocity calculated on the basis of the theory agree with observed values. Similar agreement is claimed between calculated and observed values of the height of the active monsoon stratum, and of amount of heat transferred per cm. of coastal line from sea to continent. A. E. M. G.

3974. Atmospheric Circulation and Sunspot Periods. S. Hanzlík. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 264–270, 1937. *Julius Maurer Festschrift. English Abstract.*—The variations of the general circulation of the atmosphere show in all latitudes the influence of the double sunspot period, which is particularly marked in the northern hemisphere during the winter months between the north Atlantic circulation and trade wind region on one side and winter Asiatic monsoon area on the other side in the form of a " seesaw." AUTHOR.

***3975. Atmospheric Chlorides. W. C. Jacobs.** *Monthly Weather Rev.* 65. *pp.* 147–151, *April,* 1937.—A brief description of the apparatus used and of the methods employed in the determination of the chloride content of atmospheric air is given. The observations were carried out in the Scripps Institution in 1936. The investigation shows that there is considerable chloride content in the air and that the supply is being continually replenished from the sea. A record of the various meteorological elements kept during each chloride determination shows greatest relationship between chloride content and wind velocity. Diagrams illustrate the relation between chloride content and the different elements. The author then proceeds to discuss from a theoretical point of view the nature of the nuclei. The results of other investigations are also examined. It is hoped that further determinations will be made under all possible meteorological conditions, and at all altitudes. A. E. M. G.

3976. Natural and Artificial Clouds. D. Brunt. *Roy. Meteorolog. Soc., J.* 63. *pp.* 277–289, *July,* 1937.—Clouds here dealt with are stratified showing a definite structure. They are compared with structures which can be observed in unstable layers of liquids and gases. A number of experiments which illustrate what takes place when an unstable layer of fluid breaks down are discussed. In the experimental air cell where the upper limit of the air is bounded by a movable glass plate, the motion is made visible by cigarette smoke. This enables the effect of shearing to be investigated. The results from these experiments are then applied to explain a variety of cloud forms. The forms investigated are cloud sheets with a series of clear holes, cloudlets on a blue background and clouds in rolls. The evidence of ascending currents experienced by gliding pilots is included in the investigation. Photographs of motion in experimental cells and of clouds are reproduced. A film shown at the meeting illustrated the forms taken by unstable layers during the process of breakdown, and of some clouds resembling the structures obtained in the laboratory. A. E. M. G.

3977. Cirrus Level. W. Peppler. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 156–170, 1937. *Julius Maurer Festschrift.*—The results of recent balloon observations of temperature and humidity at Munich at heights below, in, and above the cirrus level, classified according to the weather (amount of cloud, precipitation, etc.) are discussed in great detail, and compared with similar results previously obtained elsewhere. The relative importance of the various possible terrestrial origins of condensation nuclei—salt from the sea, particles from fires, etc.—is also discussed. No definite conclusions seem to be reached. C. A. S.

***3978. Humidity Measurements at Temperatures below 0°C. H. Ebert.** *Zeits. f. ges. Kälte-Ind.* 44. *pp.* 127–132, *July*, 1937.—A review of methods employed for the measurements of humidity at low temperatures in which a comparison is made of the results obtained by means of psychrometric, dew-point and absorption methods. The differences are appreciable and need for further work is indicated. Preference is given to the psychrometric and dew-point methods. Data which exist as to the performance of hair hygrometers at low temperatures is also somewhat conflicting. R. W. P.

3979. Daily Temperature Variation in Europe. R. Meinander. *Soc. Scien. Fennica, Comm. Math.-Phys.* 9. 3. [166 *pp.*], 1937. *In German.* —After a discussion of the material and the methods required for the investigation, the author proceeds to consider the effects of latitude, continentality and height above sea-level. The points principally dealt with under these headings are amplitude, times of minimum and maximum temperature, phase alteration and asymmetry of daily temperature variation. In the discussion on amplitude the effects of the strength and the direction of the wind, of the length of the day and of cloud amount are investigated and a comparison made between the amplitudes in spring and autumn. The time of minimum temperature is seen to depend on latitude and on the season of the year. Latitude does not affect the time of maximum in summer but does so in winter. These times are also seen to differ for maritime and continental stations. Maritime stations are also characterised by a phase lead, continental by a phase lag. Both show like asymmetry, slightly positive in summer, negative in winter. Numerical data are given in tabular form and a map shows the positions of the stations. A. E. M. G.

3980. Photometry of the Purple Light. P. Gruner. *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 143–149, 1937. *Julius Maurer Festschrift.*—Numerous further similar observations of twilight, made between June 1936 and April 1937 near Berne with the previously described photometer [see Abstract 569 (1936)], a selenium cell photometer, and by the naked eye are recorded and compared. These show good agreement *inter se*, and confirm the satisfactory character of the method. C. A. S.

***3981. Actinometer for Sky Radiation near the Sun. F. Linke.** *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 376–379, 1937. *Julius Maurer Festschrift.*—The essential principle consists in two similar thermo-elements with adjustable apertures in definite ratios, so arranged that the resultant currents oppose each other, and only the difference is measured. The apparatus is figured and described. C. A. S.

***3982. Belgian Stratosphere Balloon Experiment. M. Cosyns.** *Nature*, 140. *p.* 54, *July* 10, 1937.—A method of removing heated air by means of a funnel from a balloon of the dimensions of the F.N.R.S. is described. In order to calculate the minimum diameter of funnel required for a larger balloon, it is necessary to know the heating due to the sun inside the bag. To measure the heat transfer, an experimental ascent was planned with the old F.N.R.S. filled with hot air. Supplementary calories were to be supplied by a burner placed inside. A description of this burner is given. A. E. M. G.

See also Abstracts **3962, 3963.**

SEISMOLOGY.

3983. Elastic Deformation of a Stratified Body Subjected to Vertical Surface Loads. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 359–376, *June,* 1937. *In English.*—The deformation of a stratified body under vertical loads, distributed in whatever way, is virtually the same as the resultant in the superposition of different deformations, each of which is caused by a point load. Since the problem of the deformation of a body of any stratification that is subject to a point load is the same as that of a semi-infinite body, the deformation due to any point load is always directed downward. W. A. R.

3984. Energy Dissipation in Vibrations of a Bridge. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 385–393, *June,* 1937. *In English.*—The case is considered mathematically where the position of the exciting force is fixed at the middle of a bridge span, both where there is but one span, and where there are other similar spans on each side of the span in question. C. A. S.

***3985. Basle Universal Seismograph. T. Niethammer.** *Gerlands Beitr. z. Geophys.* 50. 2–4. *pp.* 307–317, 1937. *Julius Maurer Festschrift.*—In the seismological station of the University of Basle a universal seismograph with a modified Quervain-Piccard's construction has been installed. The mathematical theory of this instrument is given. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3986. Electrical Characterisation of Days. F. J. W. Whipple. *Terr. Mag.* **42.** *pp.* **129–136,** *June,* **1937.**—According to the scheme, days are characterised by the figures 0, 1, 2 according to the trace of the electrograph as regards negative potential and also by the letters a, b, c according to the range of oscillation. A comparison is made between days of different character and of different amount of rainfall at Kew for the period 1914–24. The results of a similar examination for Eskdalemuir and Lerwick for the period 1928–34 are set out in tabular form. The percentage distribution of days according to electric character for the three observatories is also given. The author next discusses electric character and diurnal variation of potential gradient. The results of this show that low average gradient on a 1a- or 2a-day is characteristic of conditions throughout the day. Also it is found that fluctuations are of a similar type on b- and c-days and on 1a- and 2a-days. A. E. M. G.

3987. Influence of Pollution on Potential Gradient at Apia. H. B. Sapsford. *Terr. Mag.* **42.** *pp.* **153–158,** *June,* **1937.**—Diurnal variation in potential gradient arises from a local variation superimposed on a single universal-time oscillation. In order to show that this local variation in Apia arises largely from pollution due to domestic fires, the author first gives a *résumé* of the habits of the Samoans regarding the lighting of fires. 264 days free from negative potential gradient are then examined. As a result it is seen that the largest positive differences from the mean occur at times of maximum smoke pollution. The effects of land and sea breezes on the maxima are next examined. The potential is found to build up while the land wind which is contaminated with smoke is blowing. With change of direction there is a drop in potential. Tables and diagrams illustrate the paper. A. E. M. G.

3988. Measure of Magnetic Activity of the Earth. A. G. McNish and A. K. Ludy. *Terr. Mag.* 42. *pp.* 173–177, *June*, 1937.—The international character figure C as a measure of magnetic storminess is considered to contain the results of too many European observatories and is further objected to on the grounds of the diversity of the observers and the delay in publishing the results. By cooperation of various interested bodies in U.S.A. an alternative figure denoted by C_A has been obtained from the results of seven American-operated observatories situated at the following places:—Cheltenham (Maryland, U.S.A.), Honolulu (Hawaii), San Juan (Puerto Rico), Sitka (Alaska), Tuscon (Arizona), Huancayo (Peru), Watheroo (Australia). The collection and distribution of the data are effected by radiotelegraphy so that the information is not more than a week in arrears. Some graphs are given showing the comparison between the international and American character figures and the quality of transatlantic radio reception for selected periods. F. S. B.

3989. Ultra-Violet Light Theory of Magnetic Storms. A. G. McNish. *Phys. Rev.* 52. *pp.* 155–160, *Aug* 1, 1937.—The three notable solar flares in the western hemisphere in 1936 did not produce magnetic storms. It is inferred from terrestrial effects accompanying them that intense u.v. emission occurred at the same time. Study of the effects suggests that, when a flare of u.v. light increases the conductivity of the lower regions of the atmosphere, increased diurnal-variation currents flow. The current-systems necessary to produce magnetic storms are of an entirely different type—hence the observed effects do not support the u.v. light theory of magnetic storms. AUTHOR.

See also Abstracts 4023, 4024, 4193.

RADIOACTIVITY.

3990. Energies of Nuclear Disintegrations. L. Goldstein. *J. de Physique et le Radium*, 8. *pp.* 235–240, *June*, 1937.—The experimental data obtained from the study of nuclear disintegrations do not supply immediately all the energy coming into play in the transformation of the nucleus, except in the case of γ-ray photons, which according to the Bohr law of frequencies are related directly to the energy levels of the nucleus. Apart from the correction for mechanical recoil, which must be related experimentally to the corpuscle emitted or absorbed by the nucleus, it must be considered that the nuclei are immersed in an assembly of extra-nuclear electrons which are translated necessarily by an adiabatic exchange of energy between the particles liberated or absorbed and the atomic electrons. These corrections of adiabatic energy due to variation in the charge of the atomic nucleus are all the more important, when the particle liberated or absorbed and the emitting or absorbing nucleus have a greater charge. In the process of natural radioactive disintegration by α-rays the adiabatic correction, although quite small, between 23·4 and 28 kV, is of the same order of magnitude as the correction for mechanical recoil. It is therefore necessary to consider these corrections simultaneously in the evaluation of the energy of disintegration. In a general manner, the adiabatic correction appears as a theoretical correction imposed by the actual representation of the atom; its appears however in principle to be verifiable by a study of the beginning of the feeble energy, approximately between 11 and 14 kV, of the continuous spectra of positive and negative electrons. T. A. C.

3991. Range of Thorium α-Particles. G. H. Henderson and G. C. Laurence. *Phys. Rev.* 52. *pp.* 46–47, *July* 15, 1937.—Recent values of this range are discussed. It is pointed out that the value found by Kurie and Knopf may be too high and that the treatment of data on a probability paper plot is unjustified in such measurements. [See also Abstract 601 (1937).] AUTHORS.

3992. Distribution of Ionisation from a Single α-Particle. L. Ürményi. *Helv. Phys. Acta*, 10. 4. *pp.* 285–310, 1937. *In German.*—The work of Ramelet on the distribution of ions from a single α-particle has been repeated; it is shown that the unexpected variations in the distribution which Ramelet found were due to the non-linearity of the amplifier used. A new type of amplifier, working in conjunction with an oscillograph, is described, and the experiments repeated in air, CO_2, O_2 and N_2. On the Bohr basis the ionisation distribution along the first part of the α-particle path is calculated. It is shown that theory and experiment are in good agreement for CO_2, whilst in air, O_2 and N_2 the observed values are respectively, 1·1, 0·8 and 1·4 times the calculated values. J. E. R.

3993. Quantisation of Theories of β-Disintegration. M. Fierz. *Helv. Phys. Acta*, 10. 4. *p.* 284, 1937. *In German.*—A correction. [See Abstract 2019 (1937).]

3994. β-Ray Spectrum of Radium E. J. S. O'Conor. *Phys. Rev.* 52. *pp.* 303–314, *Aug.* 15, 1937.—The β-ray spectrum of Ra E was examined with a magnetic spectrometer, by using coincidence counting, under various conditions of source strength, mounting and aperture of defining slits. It is concluded that the experimental high energy end point depends on the source strength used, as well as the width of the defining slits. Data from all but very strong sources gave a K.U. plot which was linear within the limits of error set by statistical fluctuations and finite slit widths. Extrapolation of the K.U. plot gave 1·25 ± 0·03 eMV as the high energy end point. AUTHOR.

3995. Coherent Scattering of γ-Rays by Nuclei. A. Achieser and I. Pomerantschuk. *Phys. Zeits. d. Sowjetunion,* 11. 5. *pp.* 478–497, 1937. *In German.*—A theoretical investigation is made of the coherent scattering of γ-rays by nuclei, using a vector matrix method. The possibility of this process of scattering follows from the Dirac theory of positrons. An assumption of intermediate energy states for the electrons is used in the development of the argument. Two particular cases are considered; firstly that of large frequencies ($h\omega \gg mc^2$), ω being the frequency while the other symbols have their usual meanings. In this case small scattering angles are of primary importance. The differential scattering cross-section is then inversely proportional to the square of the scattering angle. The total cross-section is found to have the form $\sigma = a\alpha^4Z^4(c^2/\omega^2)\log_e(h\omega/mc^2)$, where Z is the atomic number, α the fine structure constant and "*a*" a constant whose evaluation is very difficult. The second case considered is that for small frequencies, *i.e.*, $h\omega \ll mc^2$, where the total cross-section is given by $\sigma = bZ^4(\epsilon^2/mc^2)\omega^4/c^4$ where ϵ is the charge on the electron and "*b*" an undetermined numerical coefficient. The integral cross-section has a maximum at $h\omega \sim mc^2$. G. O. B.

3996. Ionisation in Air for Cosmic Rays and γ-Rays. J. Clay. *Physica,* 4. *pp.* 645–647, *Aug.,* 1937. *In English.*—From the ionisation values obtained with different collecting fields the ratio between the specific ionisation of two different radiations, *e,g.*, cosmic radiation and γ-radiation can be found from the formula $t/T = 1 + [\alpha N_0 f(x)/8\pi D)]$. From the values found at 38 atmos. and at 28 atmos. it is found that the specific ionisation of γ-rays is 3·2 times that of the final (degenerated) cosmic rays. [See also Abstract 4338 (1935).] AUTHOR.

3997. Determination of Eve's Constant in Air at High Pressures. J. Clay and M. A. v. Tijn. *Physica,* 4. *pp.* 648–650, *Aug.,* 1937. *In English.*—The method of measuring the saturation value of the ionisation in air at high pressures (147 atmos.) by shifting the value of the gas-ionisation from the wall-ionisation and by using the Jaffé-Zanstra extrapolation formula is tested by taking a calibrated quantity of Ra at 60 cm. distance and by the determination of Eve's constant. AUTHORS.

***3998. Ionisation by γ-Rays and X-Rays in Argon at High Pressures. J. Clay and G. van Kleef.** *Physica,* 4. *pp.* 651–658, *Aug.,* 1937. *In English.*—An ionisation chamber of 2·7 c.c. was constructed to measure the ionisation by γ-rays and X-rays in A at high pressures. The saturation values can be obtained by extrapolation according to the Jaffé-Zanstra formula. The constant in this formula is determined at 100 atmos. in a series of homogeneous collecting fields between 4000–100 V/cm. The occurrence of volume recombination is tested for, and the relation between the specific ionisation of different rays is determined. It appears that the degree of impurity influences the recombination in the columns. The chamber can be used as an absolute dosemeter, for γ-rays and X-rays. AUTHORS.

See also Abstracts 3795, 3801, 3810, 3855, 3960 4097, 4151, 4152, 4181.

RADIATION.

ABSORPTION AND TRANSMISSION.

***3999. Christiansen's Filters. G. Ahler.** *Comptes Rendus,* 205. *pp.* 37–39, *July* 5, 1937.—If a ray passes through a mixture of a liquid and powdered solid of the same refractive index, the width of the band transmitted is $l = n_0\psi/[(dn_l/d\lambda)_0 - (dn_s/d\lambda)_0]$, where ψ is a function of the dimensions of the apparatus and n_l and n_s refer to the liquid and solid respectively. By using aqueous solutions of various strengths together with glass, quartz or fluorine, it is possible to produce the bands over a wide range. With as nearly parallel rays as possible, bands 2 to 12 Å in width may be produced. A table of suitable solutions and solids is given. H. G. C.

***4000. Filters for Quartz Mercury-Vapour Lamps. C. Winther.** *Zeits. f. Elektrochem.* 43. *pp.* 691–695, *Aug.,* 1937.—Gives details of filters suitable for the transmission of the Hg lines 579, 546, 436, 405, 366, and 313 $\mu\mu$, the energy transmission being greater than 90 % except for the last mentioned line when it falls to 79 %. Values of the solutions and thickness required, % light transmission, % energy transmission for several wave-lengths, and effective wave-length of the filter are stated in every case. R. C. F.

See also Abstracts 3858, 3859, 4029.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4001. Magnetic Rotatory Dispersion of Tellurium Solutions. H. Bizette and M. Schérer. *Comptes Rendus,* 204. *pp.* 1931–1933, *June* 28, 1937.—Te was dissolved in concentrated H_2SO_4 and the rotatory dispersion measured in a field of 50,000 gauss. The rotation due to the Te rises to a maximum of about ½° passing through the absorption band (5000–5500 Å). The result is interpreted as suggesting that the Te is dissolved either in the form Te_2 in the Σ state, or linked with a SO_3 group. D. H. F.

4002. Paramagnetic Rotatory Power of Hydrated Ethylsulphate of Praseodymium. J. Becquerel, W. J. de Haas and J. van den Handel. *K. Onnes Lab., Leiden, Comm. No.* 244*c*. *Physica,* 4. *pp.* 543–558, *July,* 1937. *In French.*—In continuation of previous work [see Abstract 3042 (1937)], it is found that this substance when at the temperature of liquid He follows the same law of rotation as that found for the ethyl sulphates of Ds and Er. The law is expressed by two terms of which one is independent of the temperature and is of notable magnitude in the case of Pr^{+++}. The fundamental energy level of Pr^{+++} in the ethyl sulphate behaves as if doubly degenerated, and from this the component of the magnetic moment along the axis can be obtained. G. E. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4003. Extinction of Iodine Vapour Fluorescence in Magnetic Fields. E. Scholz. *Zeits. f. Physik,* 106. 3–4. *pp.* 230–235, 1937.—According to van Vleck's theory the extinction of the I_2 vapour fluorescence by magnetic fields is to be ascribed to a disturbance of the stable excited electron level by an unstable level situated very near for certain ν values. With consideration of the deviations from van Vleck's law, noticed in the results of Genard's measurements with small strengths of magnetic field, researches were undertaken on the extinction of the fluorescence of I_2 vapour excited with the Hg line 5462 Å, with small field strengths below 20,000 gauss. The lines + 1 and + 3 of the resonance series were tested and a full agreement with the theory of van Vleck was found. J. J. S.

***4004. Fluorometer Based on the Debye-Sears Effect. L. A. Tumermann and V. Šymanovskij.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 6–7. *pp.* 323–326, 1937. *In English.*—A fluorometer is described wherein the modulation of the light beam is achieved by the diffraction of light by supersonic waves in quartz. Advantages of the method as compared with the Kerr cell are that much higher light intensities are obtained, that work can be done in the u.v. region, and that no polarising prisms are necessary. A. H.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4005. Sagnac Phenomena. A. Dufour and F. Prunier. *Comptes Rendus,* 204. *pp.* 1925–1927, *June* 28, 1937.—Sagnac phenomena have been observed by an " entrained " and a " non-entrained " apparatus and the results are compared. The differences in the results are predictable on classical but not on relativistic theory. [See also Abstract 3047 (1937).] W. R. A.

4006. Sagnac's Experiment. P. Langevin. *Comptes Rendus,* 205. *pp.* 304–306, *Aug.* 2, 1937.—The author points out that Sagnac's experiment is interpretable on relativistic lines. G. C. McV.

4007. Longitudinal Light-Scattering (Plotnikow Effect). V. S. Vrkljan. *Acta Physica Polonica,* 6. 1. *pp.* 28–30, 1937. *In German.*—The author had suggested [see Abstract 4135 (1936)] that Čoban's liquids were optically impure, and claims that this criticism has not been met. He replies to Šplait's five questions. A. C. M.

4008. Critical Opalescence of Liquid Mixtures. R. S. Krishnan. *Indian Acad. Sci., Proc.* 5*A*. *pp.* 577–593, *June,* 1937.—Consequences of the theory of secondary scattering are worked out and it is found that the experimental results obtained are not in accordance with theoretical conclusions. From results obtained it is concluded that in the neighbourhood of the critical solution temperature of liquid mixtures the molecules have a tendency to group themselves in clusters and that the finite value of the depolarisation of the opalescent light is due to this fact. In the neighbourhood of T_c the secondary scattering has little effect on the depolarisation factor, although it may have an appreciable effect for $\Delta T < 0{\cdot}1°$ C. where $\Delta T = T - T_c$. The measurements of the depolarisation factors ρ_u, ρ_v and ρ_h for three binary mixtures and one ternary mixture are made over a range of temperature of 30° above T_c. The results obtained fully confirm the existence of clusters in liquid mixtures not only at the critical solution temperature but also at temperatures considerably removed from it. The theory proposed by Gans is discussed in relation to the experimental results obtained and the limitations of the theory are pointed out. The bearing of the results on the anomalies of viscosity, electric birefringence, etc., noticed by earlier investigators in the vicinity of the critical solution temperature is discussed in detail. A. H.

See also Abstracts 3922, 4004, 4015, 4127, 4128.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4009. Absorption Spectrum and Photochemical Sensitising Effect of Uranyl Sulphate in Aqueous Solution. P. Pringsheim. *Physica,* 4. *pp.* 733–745, *Aug.,* 1937. *In German.*—The sensitised photolysis of oxalic acid by uranyl sulphate cannot be explained on the basis of collisions of the second kind, since the retardation of the process by I-ions is too small. The complete absorption spectrum of uranyl sulphate in aqueous solution is photographed, and the changes in it produced by the addition of oxalic acid and of KI are measured. From the results, it is deduced that complex formation must be assumed to occur during the photolysis of oxalic acid. C. B. A.

4010. Determination of Photographic Density. A. M. Koerner and C. Tuttle. *Kodak Research Lab., Comm. No.* 612. *J.O.S.A.* 27. *pp.* 241–256, *July,* 1937.—From an examination of the factors responsible for discrepancies between the readings of existing densitometers it is concluded that the integrating sphere densitometer is best suited to serve as a standard instrument. The readings obtained using the sphere densitometer are compared with those of other densitometers and relationships are given which are found to be valid for a wide range of materials of varying grain size. Results are given for contact printing densities which are found to differ somewhat from those previously obtained by Toy, and effects previously noted with regard to opal densitometers are explained. The dependence of photographic density upon the orientation of the photographic sample is examined, and it is shown that thin metallic films on glass are unsuitable for use as standard densities as their optical properties are different from those of the photographic density. R. C. F.

4011. Theory of Photographic Development. H. D. Murray. *Phot. J.* 77. *pp.* 388–396, *June,* 1937.—A theory of development is based on the assumptions that the product of light action in the silver halide grain is a deposit of metallic silver in the neighbourhood of the development centres and that reduction of the silver halide by ordinary developers takes place only where the Ag ions of the halide lattice are not covered by adsorbed ions, the reduction being catalysed at the AgBr–Ag interface. The analysis stresses the importance of the induction period and introduces the concept of "negative development," *i.e.* Ag re-oxidised in certain circumstances. The threshold value for the mass of photolytically produced silver around a development centre depends upon the oxidising power of the developing solution and upon its Br′ content, vigorous developers starting action at a larger number of centres. Provided the threshold conditions are fulfilled the induction period (for which an expression is derived) increases linearly with increase in [Br′]. Undue increase in [Br′] will cause development to cease before the grains are fully reduced. The empirical expression for the rate of active development, $D = D_{\infty}\ (1 - e^{-K(t-t_0)})$, is shown to be consistent with the foregoing assumptions and an explanation is offered of the effects produced by small additions of iodides and thiosulphates to developers. L. V. C.

4012. Spectral Distribution of Sensitivity of Optically Sensitised Layers of Silver Halide at Low Temperature. G. Ungar. *Zeits. f. Physik,* 106. 5–6. *pp.* 322–328, 1937.—Agfa Lupex paper is treated with various sensitising materials and the spectral distribution of photographic sensitivity determined with the paper immersed in liquid air. With a number of sensitisers, notably eosin and pinachrom violet, the sensitivity in the long-wave region disappears completely on cooling. In other cases, *e.g.*, pinacyanol, the sensitivity is not much more depressed in the red than in the blue. Changes in the absorption spectra of the sensitisers are insufficient to account for these results, which must be due to the effect of cooling upon the mechanism of energy exchange between the sensitiser and the silver halide. L. A. W.

4013. Optical Investigations of Latent Image and Print-Out Effect of Photographic Emulsions. A van Kreveld and H. J. Jurriëns. *Physica*, 4. *p.* 746, *Aug.*, 1937. *In English.*—Corrections to the original article [see Abstract 2563 (1937)].

4014. Three Colour Reproduction. A. C. Hardy and F. L. Wurzburg, Jr. *J.O.S.A.* 27. *pp.* 227–240, *July*, 1937.—Deals theoretically with the principles of three colour reproduction, showing how the characteristics of the visual apparatus of the observer may be correctly embodied in a general theory, and demonstrating the inadequacy of the prevalent purely objective theory. After deriving the theoretical requirements for exact colour reproduction, the application of the theory to additive and subtractive processes, and the realisation of receptors having the required spectral sensitivity are discussed. R. C. F.

4015. Light Scatter from Photographic Lenses. L. V. Chilton. *Phot. J.* 77. *pp.* 381–387 *with Disc., June*, 1937.—The light scattered by a series of typical photographic lenses was examined by plotting the illumination from point to point in the image of a uniformly bright plane subject including a small totally dark area whose position could be varied, the illumination of the image of this small area being wholly due to scatter. The ratio, at any image point, of diffuse to total illumination increases with the number of air-glass interfaces in the lens assembly and is of the same order as that calculated for the axial beam, assuming the " scatter " to be due to internal reflection; as a typical result the ratio amounts to about 0·04 for a lens of mean refractive index 1·55 having 8 air-glass interfaces. Such scatter may have an appreciable softening effect on the image of line subjects. Examples of this effect are analysed, showing the necessary increase in photographic " gamma " required to minimise the consequent tone-distortion. L. V. C.

***4016. Fog-Safety of Dark-Room Lamps. O. Reeb.** *Phot. Indust.* 35. *pp.* 778–780, *July* 21, 1937.—Suggests a method for determining the safety from fogging of dark-room lamps, and gives the difficulties likely to be met with in the carrying out of such measurements. R. C. F.

***4017. Testing Synchronisers. J. A. M. van Liempt and J. A. de Vriend.** *Physica*, 4. *pp.* 703–714, *Aug.*, 1937. *In English.*—A short description of synchronisers as they are used in photo-flash lamp photography is given and their value for practice set out. A method of determining the time constant of a synchroniser and its fluctuation with the aid of a kathode-ray tube is given, together with figures for existing specimens. It is pointed out, that the flash time of photoflash lamps with regard to their use in combination with synchronisers should not be too short. A practical and inexpensive method is described for adjusting synchronisers which enables every photographer to adjust his own synchroniser on his own camera. AUTHORS.

See also Abstracts 4022, 4039.

PHOTOMETRY.

*4018. **Slit Photometer for Analysis of Coloured Solutions: Experimental Proof of Diffusion Equation. W. G. Eversole and E. W. Doughty.** *J. Phys. Chem.* 41. *pp.* 663–671, *May,* 1937.—A new and accurate photometric apparatus for the analysis of thin sections of coloured solutions is devised and applied to measurements of the diffusion of methylene blue. The relation $m = m_0 e^{-x^2/4Dt}$ is shown to be in agreement with the results of experimental measurements. The diffusion coefficient of methylene blue in 5 % gelatin gels at 25° C. is $1 \cdot 635 \times 10^{-6}$ cm^2. per sec. AUTHORS.

See also Abstracts 3962, 3980.

POLARISATION.

4019. **Attractive Power and Solvent Effect on Rotation. T. S. Patterson and Gladys M. Holmes.** *Chem. Soc., J. pp.* 1403–1406, *Aug.,* 1937.—Although the rotation of optically active compounds often varies greatly with the nature of inactive liquids used as solvents, no satisfactory suggestion has hitherto been made to correlate any property or properties of the solvent with the alteration thus produced. The experiments here described had their origin in the idea that if an active compound, such as ethyl tartrate, were distributed between two, so-called immiscible, solvents, the relative attractive power, as it may be termed, of these two solvents for the ethyl tartrate might show some proportionality to the corresponding changes in rotation. [See Abstract 2575 (1937) and following Abstract.]

4020. **Asymmetric Solvent Action. T. S. Patterson and A. H. Lamberton.** *Chem. Soc., J. pp.* 1453–1459, *Aug.,* 1937.—In the present work an attempt is made to ascertain whether the volume of *iso*butyl *d*-tartrate in *l*-menthyl acetate is different from that of *iso*butyl *l*-tartrate, using solutions of about 5 % concentration. Two sets of determinations were carried out by different observers, using different material and at an interval of 31 years. Both sets showed a slight and very similar difference, several times as great as the estimated probable error. In the second series of observations the volume of the same samples of the tartrates was similarly determined in the symmetrical solvent nitrobenzene, and unexpectedly, a difference almost similar in amount to that obtained in the asymmetrical solvent was found. The experiments are thus a little inconclusive, but it seems to be established with some definiteness that the volume of these two antimers, within the limits of experimental error, is the same in the asymmetrical as in the symmetrical solvent. [See preceding Abstract.] AUTHORS.

4021. **Circular Dichroism in the Ultra-Violet. Part I. R. Tsuchida.** *Chem. Soc. Japan, Bull.* 12. *pp.* 276–285, *June,* 1937.—The mathematical basis of an accurate method of measuring circular dichroism is developed in detail, and the range of applicability of an approximate equation is examined. Measurements of the light absorption, rotatory dispersion, and circular dichroism in the visible and ultra-violet are plotted for ammonium α-bromocamphor π-sulphonate. N. M. B.

4022. **Flow Dichroism of Fluorescein Solutions. S. Nikitine.** *Comptes Rendus,* 205. *pp.* 124–126, *July* 12, 1937.—When monochromatic, polarised light passes through glycerin solutions of fluorescein contained between two co-axial cylinders the maximum absorption is in a direction 1 and the minimum absorption in a direction at 90° to 1. The rotation is at a maximum midway between these two directions. The orientation of the two directions changes with the rate of flow. [See also Abstract 2569 (1937).] W. R. A.

See also Abstracts 4004, 4008, 4084, 4085.

RADIATION, EMISSION.

4023. Influence of Earth's Magnetic Field on Cosmic-Ray Intensities up to Top of Atmosphere. I. S. Bowen, R. A. Millikan and H. V. Neher. *Phys. Rev.* 52. *pp.* 80–88, *July* 15, 1937.—Accurate observations were made of cosmic-ray intensities up to 98 % of the total height of the atmosphere, using Neher electroscopes, at magnetic latitude 3° N. Equilibrium between the incoming radiation and its secondaries was reached before 10 % of the atmosphere had been penetrated, the intensity thereafter falling off exponentially. The differences between this curve and those obtained previously at magnetic latitudes 38·5° N. and 53° N. fix the complete curves of ionisation of particles produced in the atmosphere by incoming charged particles having energies in the ranges $2{\cdot}5 - 6{\cdot}7 \times 10^3$ eMV and $6{\cdot}7 - 17 \times 10^3$ eMV. These are reasonably in accord with the Bethe and Heitler theory as extended by Carlson and Oppenheimer. It is concluded, from a consideration of absorption coefficients, that the particles causing the latitude effect and the E-W effect are of the same type, and are electrons, chiefly positive, rather than protons. D. H. F.

4024. Cosmic Rays and the Earth's Magnetic Field. E. M. Bruins. *Physica*, 4. *pp.* 659–666, *Aug.*, 1937. *In English.*—Intensity measurements of cosmic rays at constant latitude or at constant distance from the magnetic centre of the earth are compared. The earth's magnetic effects cannot be explained by assuming a single dipole. The discrepancy is of the order of 4–5 %. It will be necessary though not sufficient, to take into account the quadrupole moment. Evidence is given, that local magnetic disturbances have an effect on the cosmic-ray intensity, in the South Pacific as well as in the South Atlantic. [See also Abstract 4229 (1935).] AUTHOR.

4025. Directional Measurements of Cosmic Rays. E. Lenz. *Ann. d. Physik*, 29. 8. *pp.* 741–757, *Aug.*, 1937.—It was found that on the Jungfraujoch (3450 m.) the numbers of the hard positive and negative particles, capable of penetrating 8 cm. of Fe, incident in the E-W plane in a direction of 33·5° W. from the horizontal were appreciably equal. Measurements were performed with counters, using an electrical field to deviate the particles. Measurements of the energy loss in passing through 2 cm. of Fe were made: a lower limit of 27×10^6 eV/cm. was found for the loss. It was found that the shower frequency fell off more quickly with increasing zenith angle than did the counting rate for single particles. D. H. F.

See also Abstracts 3996, 3997, 3998, 4105, 4111, 4151.

RADIATION, GENERAL THEORY.

4026. Radiation Field of the Electron. F. Bloch and A. Nordsieck. *Phys. Rev.* 52. *pp.* 54–59, *July* 15, 1937.—Previous methods of treating radiative corrections in non-stationary processes such as the scattering of an electron in an atomic field or the emission of a β-ray, by an expansion in powers of e^2/hc, are defective in that they predict

infinite low frequency corrections to the transition probabilities. This difficulty can be avoided by a method developed here which is based on the alternative assumption that $e^2\omega/mc^3$, $h\omega/mc^2$ and $h\omega/c\Delta p$ (ω = angular frequency of radiation, Δp = change in momentum of electron) are small compared to unity. In contrast to the expansion in powers of e^2/hc, this permits the transition to the classical limit $h = 0$. External perturbations on the electron are treated in the Born approximation. It is shown that for frequencies such that the above three parameters are negligible the quantum mechanical calculation yields just the directly reintepreted results of the classical formulæ, namely that the total probability of a given change in the motion of the electron is unaffected by the interaction with radiation, and that the mean number of emitted quanta is infinite in such a way that the mean radiated energy is equal to the energy radiated classically in the corresponding trajectory. [See following Abstract.]
AUTHORS.

4027. Low Frequency Radiation of a Scattered Electron. A. Nordsieck. *Phys. Rev.* **52.** *pp.* **59–62,** *July* **15, 1937.**—The radiative scattering of a non-relativistic electron is treated by an approximate method which neglects the reaction of the radiation field on the motion of the electron. In this approximation the different modes of oscillation of the radiation field are independent of one another, and can therefore be treated individually. For frequencies of the radiation small compared to the inverse impact time of the electron, it is shown that the probability of emitting any finite number of quanta is zero, and that the mean radiated energy depends only on the total change in velocity of the electron, the amount of energy radiated being given by the same formula as in classical theory. [See preceding Abstract.] AUTHOR.

See also Abstract **4121.**

REFLECTION, REFRACTION AND DISPERSION.

4028. Intensity of Light Reflected from a Parallel Plate. W. E. Anderson. *J.O.S.A.* **27.** *pp.* **300–302,** *Aug.,* **1937.**—An equation is derived for the intensity of light reflected from a parallel plate without assuming Stokes' law to hold or a fixed phase change of π on external reflection. It is shown that this equation reduces to equations generally used in describing this intensity only under conditions which are probably never applicable. AUTHOR.

4029. Optical Properties and Structure of Thin Gold Films. P. J. Haringhuizen, D. A. Was and A. M. Kruithof. *Physica,* **4.** *pp.* **695–702,** *Aug.,* **1937.** *In English.*—Reflectivity and transmission of gold films of known thickness are measured as a function of wave-length. The quantities n and k are determined from these experiments. For a thickness below 10 mμ n and k vary due to the decrease of the mean free path of the free electrons. The light-absorption of the thinnest films is explained with the help of the hypothesis, that they consist of gold in amorphous state. Some ultramicroscopic observations show that the colours of thin films cannot be explained on the basis of the idea of a colloidal structure of the films. Some results of recrystallisation are discussed. AUTHORS.

***4030. Axial Chromatism of Telescope Objectives. T. Malinowski.** *Rev. d'Optique,* **16.** *pp.* **121–141,** *April,* **1937.**—The author studies three objectives, each consisting of a cemented doublet, which differ only in the dispersion of the glass of the negative component. The position, diameter and brightness of the axial astigmatic images given by each objective for a series of wave-lengths throughout the spectrum are calculated. Using these results the author deduces the conditions in which the total image given by the objective when the incident light is white, appears to the eye to have maximum sharpness. A general criterion for the correction of axial chromatism is enunciated. W. S. S.

4031. Refractive Indices of Liquid Oxygen, Nitrogen, and Hydrogen. H. E. Johns and J. O. Wilhelm. *Canad. J. of Research,* 15. *Sect. A. pp.* 101–108, *July,* 1937.—The refractive indices of liquid O_2, N_2, and H_2 at temperatures ranging from the normal boiling point to the normal freezing point of the liquefied gases were determined by means of a Wollaston cell for the wave-lengths 6939, 5461, and 4358 Å. The values obtained at the normal boiling point for 5461 Å were: O_2, 1·2242; N_2, 1·1990; H_2, 1·1120. AUTHORS.

4032. Vectorial Calculation of Refraction in a Prism. M. Szulc. *Acta Physica Polonica,* 6. 2. *pp.* 103–108, 1937. *In French.*—A general treatment of the problem is given and allowance is made for internal reflections. Use of a graphical method simplifies the problem. H. G. C.

4033. Birefringence of Quartz in the Far Ultra-Violet and Schumann Regions. R. Servant. *Comptes Rendus,* 205. *pp.* 230–231, *July* 19, 1937.—The birefringence of quartz in the u.v. was known down to 1850 Å. Measurements are now extended, with a vacuum apparatus, as far as 1450 Å, the practical limit imposed by the opacity of the thin laminæ of crystal employed. The increase of birefringence in the Schumann region is very marked. Lowry and Adams formulæ give the magnitude of the birefringence, but the values are all too low, indicating that a modification of the formulæ is necessary. [See Abstract 4171 (1936).] C. J. B. C.

***4034. Range Finders. H. v. Keller.** *V.D.I.* 81. *pp.* 777–782, *June* 26, 1937.—The principles underlying different methods of measuring the distances of remote objects are outlined and the limits of accuracy obtainable are calculated. Various monocular and binocular range finders are described briefly. W. S. S.

See also Abstracts 3812, 3823, 3884, 3885, 4015.

SPECTROSCOPY.

4035. Interferometer Wave-Lengths in the Secondary Spectrum of Hydrogen. R. G. Lacount and R. E. Hodgdon. *Phys. Rev.* 52. *pp.* 98–99, *July* 15, 1937.—Interferometer determinations of the wave-lengths of 34 lines in the spectrum of H_2 have been made, using an etalon crossed with a Littrow spectrograph. The average probable error of these measurements is 0·0003 Å. AUTHORS.

4036. Infra-Red Arc Spectrum of Mercury. G. Wiedmann and W. Schmidt. *Zeits. f. Physik,* 106. 5–6. *pp.* 273–278, 1937.—Using a new type of prism spectrograph with a dispersion of 18 Å./mm. at 10,000 Å. the near infra-red spectrum of the Hg arc has been examined. The wave-lengths and intensities of about 240 lines are listed. W. R. A.

4037. Bergmann Series of Cæsium. K. W. Meissner and W. Weinmann. *Ann. d. Physik,* 29. 8. *pp.* 758–760, *Aug.,* 1937.—The lowest triplet of the Bergmann series of Cs, $5^2D_{3/2,5/2} - 4^2F_{5/2,7/2}$, which lies in the infra-red at about 10,000 Å is measured interferometrically and the structure of the $4^2F_{5/2,7/2}$ term determined. This term, like all other F-terms of

Cs is found to be inverted ; its separation amounts to $\Delta\nu = 0\cdot177$ cm^{-1}. J. E. K.

4038. Stratified Geissler Discharge in Different Gases at Atmospheric Pressure. J. Jaffray. *Comptes Rendus*, 205. *pp.* 32–33, *July* 5, 1937.—It is suggested that it should be possible to observe in a magneto discharge the stratifications in the positive column similar to those observed in discharge tubes. These were not detected in free air, but were observed and photographed when the discharge between Ni electrodes took place in a glass tube containing various gases at approximately atmospheric pressure with traces of impurities, and were accompanied by phenomena characteristic of chemical action. The photograph shows that the discharge commences with a weak spark and continues immediately with the Geissler stratified discharge. [See Abstract 662 (1937).] N. M. B.

4039. Ultra-Violet Emission Spectrum of the Slow Thermal Dissociation of Silver Azide. R. Audubert. *Comptes Rendus*, 205. *pp.* 133–135, *July* 12, 1937.—The slow thermolysis of silver azide is accompanied by a photogenic process corresponding with three bands at approximately 2150, 2300 and 2400 Å. W. R. A.

4040. Extreme Ultra-Violet Spectrum of Sb. L. Bloch and E. Bloch. *J. de Physique et le Radium*, 8. *pp.* 217–228, *June*, 1937.—Using a h.f. electrodeless discharge and gratings of 18 and 3 to 4 Å/mm. dispersion the Sb spectrum has been photographed between 2400 and 200 Å. Lines due to different stages of ionisation were identified by varying the voltage. Previous results are largely verified, but new schemes are suggested for Sb VI and Te VII. H. G. C.

4041. Deep Terms in the Spectra of Sc VIII and Sc IX. P. G. Kruger and L. W. Phillips. *Phys. Rev.* 52. *pp.* 97–98, *July* 15, 1937.—23 lines in the Sc spectrum have been identified as radiations connecting higher terms with the ground states of Sc VIII and Sc IX. AUTHORS.

4042. Extreme Ultra-Violet Series in Cr VI, Mn VII and Fe VIII. P. G. Kruger and S. G. Weissberg. *Phys. Rev.* 52. *pp.* 314–317, *Aug.* 15, 1937.—Lines in the extreme u.v. region involving the $3d^2D$, $4p^2P$, $5s^2S$, $6s^2S$, and several nf^2F terms have been identified in the spectra of Mn VII and Fe VIII. In Cr VI the first member of the $3d^2D-nf^2F$ series has been found. These spectra have been photographed with a 21-ft. grazing incidence vacuum spectrograph. Identification was facilitated by the use of constant second difference displaced frequency diagrams. AUTHORS.

4043. Sodium Spectrum and Structure of ^{2}D-Terms. K. W. Meissner and K. F. Luft. *Ann. d. Physik*, 29. 8. *pp.* 698–712, *Aug.*, 1937.—NaI lines of a sharpness considered unattainable in other sources are excited by electron collisons in a Na atomic beam and are measured by a Fabry-Perot interferometer, the direction of observation of which is at right angles to the direction of the atomic beam. The large etalon separations used, 36 mm. and 60 mm., permit high resolution with an accuracy of measurement of $\pm 0\cdot0005$ Å. The members of the second subsidiary series are found to have a separation, $3^2P_{1/2}-3^2P_{3/2}$, of 17·1963 cm^{-1}. All measured lines of the first subsidiary series exhibit inverted term arrangement, in the case of two of the lines all three components are resolved. The separations of ^{2}D-terms are as follows: 3^2D = 0·0494 cm^{-1}., 4^2D = 0·0346 cm^{-1}., 5^2D = 0·0230 cm^{-1}., 6^2D = 0·0124 cm^{-1}. Several term values are re-calculated on the basis of the new measurements. J. E. K.

4044. Sodium Spectrum. K. W. Meissner and E. Ebbinghaus. *Ann. d. Physik,* 29. 8. *pp.* 713–714, *Aug.,* 1937.—Wave-lengths of Na lines emitted from a Geissler discharge are measured and compared with previous measurements [see Abstract 2605 (1937)], in which the lines were excited in an atomic beam. It appears that there can be at the most only a very small difference between the wave-lengths of lines excited by these two methods. J. E. K.

4045. Possible Electronic Transitions and Absorption Spectra of Nd^{+3} Ions in Solution and in Crystals. P. C. Mukherji. *Indian Journ. Phys.* 11. *pp.* 123–141, *May,* 1937.—The absorption spectra of Nd^{+3} ions have been investigated from 900 mμ to 200 mμ using solutions and single crystals of NdCl$_3$,6H$_2$O. Crystals have been studied from room- to liquid-air temperature; at low temperatures the sharp absorption lines and bands of Nd^{+3} ions are distributed in groups situated apart from one another and a complete list of their wave-lengths and wave-numbers is given. A classification of the absorption spectra in which each group is regarded as due to an electronic transition from the ground to an allowed inner level of the ion is given. The appearance and disappearance of groups of faint lines at the temperature of liquid oxygen are discussed and evidence is obtained of the presence of a lower excited level about 249 cm^{-1}. above the basic level in close agreement with the splitting of the ground level of Nd^{+3} ions in a cubic field calculated by Penney and Schlapp. [See Abstract 5559 (1936).] W. R. A.

4046. Energy Distribution and Behaviour of Mercury Spectrum at High Vapour Pressure. T. Harada and T. Azuma. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 677–692, *July,* 1937. *In English.*—The relative energy distribution in the commercial type quartz capillary Hg lamp at about 30 to 40 atmos. of Hg vapour pressure is studied between 2400 to 17000 Å. At these high vapour pressures the lines in the u.v. region decrease in intensity generally. The strongest line is 5461 and about 2/3 of the luminosity of the line spectrum is due to it in these lamps. The spectrograms of the specially constructed quartz capillary Hg lamps are taken between 2300 to 11000 Å and up to 100 atmos. of Hg vapour pressure. All the arc lines with a few exceptions shift and broaden asymmetrically to the long wave-length side. The widths of the broadest lines (10140, 2537) are about 150 Å at 100 atmos. The lines of which the initial terms are about 9·5 volt or higher, *i.e.,* $m = 4$ or higher in the Russel-Saunders notation disappear in the continuous background at 100 atmos. All the lines which remain relatively sharp up to about 30 atmos. or higher vapour pressure belong to the sharp series. Between about 4000 to 5400 Å there appear some diffuse emission bands. AUTHORS.

4047. Intensity Measurements in the Spectrum of Helium. H. C. Burger, J. B. van Milaan and L. S. Ornstein. *Physica,* 4. *pp.* 730–732, *Aug.,* 1937. *In English.*—The ratio of the intensity of the line $2^3P - 4^3D$ (4472 Å) to that of $3^3P - 4^3D$ (17003 Å) of He is measured at pressures from 3·7 to 40 mm. of Hg and at current intensities from 10 to 120 mA. The value obtained, $8 \cdot 8 \pm 0 \cdot 5$, is independent of conditions and agrees with Hylleraas' unpublished theoretical value of 8·65. For the singlet lines $2^1S - 4^1P$ and $3^1S - 4^1P$ (3965 and 15088 Å respectively) at 7 mm. Hg and 23–65 mA, the ratio obtained is 12 ± 1, as compared with the theoretical value of 17·83. [See following Abstract.] C. B. A.

4048. Theoretical Calculation of Transition Probabilities in Helium. E. A. Hylleraas. *Zeits. f. Physik,* 106. 5–6. *pp.* 395–404, 1937.—The squares of the matrix elements and the oscillator strengths of the individual spectral lines of He are calculated from the previously determined approximate characteristic functions. In the approximate characteristic functions the polarisation of the atomic core is not taken into account, hence the theoretical data derived are to be regarded as providing only a basis for preliminary comparison by the spectroscopist. It is hoped later to estimate or exactly calculate the influence of the polarisation effect. Some theoretical values are compared with numerical data obtained from absorption measurements by Levy and from intensity measurements of emission spectra by Burger [see preceding Abstract]. J. E. K.

4049. Hyperfine Structure of the λ 4336·89, sp^{33}D$_2$ – 5p^{3}D$_1$ Line in the First Spark Spectrum of Arsenic and its Nuclear Spin. S. K. Mukerji. *Indian Journ. Phys.* 11. *pp.* 213–217, *July*, 1937.—The hyperfine structure of the λ4336·89, $sp^{33}D_2$—$5p^3D_1$ line in the first spark spectrum of As is studied and it is found that this line is a perfectly resolved, sharp, regular quartet degraded to the violet. The components are at intervals of 159, 115 and 67. It is found that this line follows the interval and intensity rules with remarkable accuracy. The analysis definitely shows that the nuclear spin of arsenic is 3/2 as previously proposed by S. Tolansky.

4050. Origin of Quadripolar Moments of Atomic Nuclei. J. Solomon. *Comptes Rendus*, 204. *pp.* 1935–1938, *June* 28, 1937.—The deviations from the interval rule deduced from the hyperfine structure of spectra can be interpreted by assigning to the atomic nucleus, in addition to its magnetic moment, an electric quadripole moment [see Abstract 1199 (1936). These quadripole moments correspond with what might be expected if the protons of the nucleus are not distributed in spherical symmetry. This view is supported mathematically, and it is shown that the higher value of the nuclear radius proposed by Bethe [see Abstract 161 (1937)] is not incompatible with the nuclear quadripole moment being due to a single nuclear particle. C. A. S.

4051. Magnetic Moments of Atomic Nuclei. T. Schmidt. *Zeits. f. Physik*, 106. 5–6. *pp.* 358–361, 1937.—Two diagrams are given which show the relation between the mechanical nuclear moment and the magnetic moment for (1) odd proton and even neutron numbers and (2) even proton and odd neutron numbers. Both diagrams show that the magnetic nuclear moment is not distributed regularly; in both cases it lies on two parallel lines which, for odd proton numbers, have a slope of approximately 1, whilst for odd neutron numbers they have zero slope. H. J. H. S.

4052. Magnetic Nuclear Moment of K^{39}. K. W. Meissner and K. F. Luft. *Zeits. f. Physik*, 106. 5–6. *pp.* 362–364, 1937.—The hyperfine structure of the K resonance lines 7665 and 7699 Å is examined with an interferometer, using a luminous atomic beam as a light source. The splitting of the $^2S_{1/2}$ terms gives $\Delta\nu = 0{\cdot}0156$ cm^{-1}. (which is in agreement with earlier measurements) and for the $^2P_{1/2}$ terms $\Delta\nu = 0{\cdot}0021$ cm^{-1}. The order of the terms is regular (which does not agree with the measurements of Jackson and Kuhn), the magnetic nuclear moment is positive (in agreement with the magnetic deflection experiments) and has a value of 0·04 and 0·30 for the $^2S_{1/2}$ and $^2P_{1/2}$ terms respectively. H. J. H. S.

4053. Theory of Fine Structure of Helium. G. Araki. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 592–608, *June*, 1937. *In English.*—

The theory of the Sl-triplet of He recently worked out [see Abstract 2101 (1937)], has been extended to the case of $1s^2 2s\ 2p^3P$, $1s^2 2s\ 3d^3D$ and $ls^2 2s\ 4f^3F$ of Be, B^+, C^{++}, N^{+++} and O^{++++}. The calculated values are in good agreement with experimental data. The departure of separation ratios from Landé's rule are quantitatively explained. The paper is theoretical. F. S.

4054. Emission Spectra of Metallic Salts. P. Mesnage. *Comptes Rendus*, 204. *pp*. 1929–1931, *June* 28, 1937.—Continuing the investigation of the visible and u.v. molecular emission spectra of metallic halides in the h.-f. discharge [see Abstract 2104 (1937)] no molecular spectrum is found with NiI_2, MnI_2 and $CrBr_3$. $NiBr_2$ and $CoBr_2$ exhibit rich band spectra, attributed to the diatomic molecules NiBr and CoBr. In the case of the $NiBr_2$ spectrum, it is suggested that the principal bands can be grouped in three systems, having a common electronic lower level, which would be the fundamental state of the molecule, with a vibration frequency of about 350 cm^{-1}. In the case of CoBr two groups are suggested, with a common lower level of about 310 $cm.^{-1}$. D. H. F.

4055. Fine Structure of the 5998·9 Band of NO. C. Jausseran, L. Grillet and M. Duffieux. *Comptes Rendus*, 205. *pp*. 39–41, *July* 5, 1937.—The rotation structure of this band has been given [see Abstract 2212 (1936)]. Using a grating giving a dispersion of 2·26 Å/mm. in the second order, the fine structure of the lines was obtained. Both the P and R lines are triple and definitely belong to the same band. It is possible that Q branches are present. The band is not connected with the known Σ states of NO. The triplet structure supports its attribution to NO^+. **Errata,** *ibid. p*. 343, *Aug*. 2, 1937. H. G. C.

4056. Intermolecular Association and Infra-Red Absorption of Water. G. Bosschieter and J. Errera. *J. de Physique et le Radium*, 8. *pp*. 229–232, *June*, 1937.—The absorption of H_2O liquid, gaseous and in solution is examined at about 3μ. A band at 3520–3700 cm^{-1}. is monomolecular, being independent of the solvent. A band about 3300 cm^{-1}. arises from H bonds. H. G. C.

4057. Near Infra-Red Absorption Band of Liquid Water at $1\cdot79\mu$. J. R. Collins. *Phys. Rev*. 52. *pp*. 88–90, *July* 15, 1937.—The near infra-red absorption band of liquid water at $1\cdot79\mu$ is studied at various temperatures. No apparent changes in the band are detected in the temperature range from 4° C. to 137° C. AUTHOR.

4058. Effect of Hydrogen Bonding upon the Infra-Red Absorption of the Hydroxyl Group. A. M. Buswell, V. Deitz and W. H. Rodebush. *J. Chem. Phys*. 5. *pp*. 501–504, *July*, 1937.—A detailed account of work on the fundamental band of the OH group. Substances capable of forming H-bonds, *o*-nitrophenol, 2,4 dinitroresorcinol, 2·4 dinitrophenol, 2·6 dinitrophenol, trinitrophenol, methyl salicylate, and salicaldehyde, show very strong absorption at about 3350 cm^{-1}. quite distinct from C-H absorption and independent of the solvent used. *p*-nitrophenol and *o*-nitroanisole, which are incapable of H-bonding, were examined and the results indicated that the absorption peak was not due to C-H. Since exchange between hydroxylic H and D takes place readily in the absence of catalysts, *o*-nitrophenol and other H-bonding substances have been brought in contact with pure D_2O for some minutes, the D_2O then distilled off *in vacuo* and the deuterated substance dissolved in CCl_4. The absorption spectrum was investigated. The CCl_4 solution was then allowed contact with H_2O vapour for 30 min. and the absorption curve determined.

The considerable deuteration which took place is completely removed by the exposure to H_2O vapour for 30 min. Several alcohols have been examined at various dilutions and in the pure liquid state. The results indicate complete H-bonding in the liquid state, and as the dilution increases the extent of H-bonding diminishes and the spectrum approximates more closely to the spectrum of the alcohol vapour. [See Abstract 2484 (1936).] W. R. A.

4059. Spectroscopic Studies of the Hydrogen Bond. Part I. Association Equilibrium in Acetic Acid Vapour. R. M. Badger and S. H. Bauer. *J. Chem. Phys.* 5. *pp.* 605–608, *Aug.*, 1937.—The association equilibrium in the vapour of acetic acid has been studied by photometric measurement of the intensity of a narrow O-H band at λ9750 which appears to be characteristic of the single molecules. The results are in reasonable agreement with vapour density measurements, indicating that the association is at least largely due to H-bond formation and that two H-bonds are formed in the majority of the double molecules. An O-H absorption characteristic of the double molecules could not be observed in the vapour state, due to insufficient path length, but in the liquid and in carbon tetrachloride solutions a broad band was found with maximum around λ10,100. It is suggested that the spectroscopic criterion for the presence of H-bonds is not the disappearance but rather the shift and modification of the O-H absorption. AUTHORS.

4060. Infra-Red Absorption of Hydrocarbons. F. W. Rose. *Bureau of Standards, J. of Research,* 19. *pp.* 143–161, *Aug.*, 1937.—The absorption spectra of 9 hydrocarbons of low molecular weight (C^8 to C^{10}) and of 10 hydrocarbons of high molecular weight (C^{22} to C^{32}) are recorded in the near infra-red from 5400 to 8900 cm^{-1}. ($1\cdot82$ to $1\cdot12\,\mu$) with a recording infra-red glass spectrograph. Molal absorptive indices are calculated and plotted against wave numbers. Qualitative correlations of the differences in the various spectral characteristics of certain structural types are noted and some limitations on such interpretations indicated. These data can now be correlated quantitatively with respect to structural units of hydrocarbon molecules. The results will follow in a subsequent report. AUTHOR.

4061. Absorption Spectrum of Bivalent Samarium. F. D. S. Butement and H. Terrey. *Chem. Soc. J. pp.* 1112–1113, *July,* 1937.—The absorption spectrum of $SmCl_2$ solution has been studied, and the positions of the main bands measured. It shows considerable similarity to that of europic chloride, as was to be expected theoretically, but owing to the greater nuclear charge in Eu^{+++} its wave-lengths are slightly shorter than those for Sm^{++}. However, although the bands of Eu are extremely narrow, those of bivalent Sm are among the broadest shown by any rare-earth compound. Experimental details are included. H. H. Ho.

4062. Ultra-Violet Absorption Spectrum of Benzene. G. B. Kistiakowsky and A. K. Solomon. *J. Chem. Phys.* 5. *pp.* 609–616, *Aug.*, 1937.—The variation of the u.v. absorption spectrum of benzene with temperature has been studied. From the Boltzmann distribution function two fundamental frequencies of the normal state are deduced. One is best identified with the Raman frequency of 404 cm^{-1}., whereas the other is possibly the 605 cm^{-1}. vibration, but may be somewhat lower. The significance of these findings for the interpretation of the u.v. spectrum of benzene is discussed. AUTHORS.

4063. Ultra-Violet Absorption Spectra of Deuterium-Substituted Methylamines. T. Förster and J. C. Jungers. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 387–397, 1937.—Fortuitous numerical relationships between the frequencies render difficult the interpretation of the u.-v. absorption spectra of ordinary methylamine. The absorption spectra of CD_3NH_2, CH_3ND_2 and CD_3ND_2 below 2400 Å are now investigated and compared with that of the unsubstituted substance. It is found that in each case the band differences can be represented in terms of two vibrational frequencies. It is concluded that both of these are to be ascribed to an excited state of the molecule. The remarkable differences in the appearances of the spectrograms, which are reproduced, are due to fortuitous frequency relationships and not to essential differences in the mechanism of the nuclear vibrations. Quantitative experiments on the exchange of D from D_2O to methylamine support the ordinarily accepted structure of the latter molecule. L. A. W.

4064. New Absorption Spectrum of S_2. P. W. Schenk. *Zeits. f. Physik,* 106. 3–4. *pp.* 271–272, 1937.—In contradiction to the views expressed by Cordes [see Abstract 2634 (1937)], it is maintained that the spectrum in question is due to SO, reasons for this being stated. F. S.

4065. Band Spectra and Energy of Dissociation of the Rubidium Molecule. Ny Tsi-Zé and Tsien San-Tsiang. *Phys. Rev.* 52. *pp.* 91–96, *July* 15, 1937.—Measurements and vibrational analysis of the violet and blue band systems of Rb_2 have been made in absorption. Quantum numbers have been assigned to 118 and 160 bands in the two systems, respectively. The upper vibrational frequency of the violet system is $40 \cdot 42$ cm^{-1}. and that of the blue one, $36 \cdot 46$ cm^{-1}. The lower level, common to the two systems, is $^1\Sigma$ ground state, and its vibrational frequency is found to be $57 \cdot 45$ cm^{-1}. The energies of dissociation of the three states of the molecule have been determined by means of extrapolation, and the value for the ground state is $0 \cdot 49 \pm 0 \cdot 02$ volt. A green edge of the blue system at 5032 Å has been observed. AUTHORS.

4066. Bands of HD and D_2 Ending on the $2p^1\Sigma$ State. G. H. Dieke and Margaret N. Lewis. *Phys. Rev.* 52. *pp.* 100–125, *July* 15, 1937.—Two extensive band systems of HD and D_2, $3d^1\Sigma \rightarrow 2p^1\Sigma$ and $3d^1\Pi \rightarrow 2p^1\Sigma$ are given and described and a few weaker and less complete systems ending on the same state. The rotational constants of $2p^1\Sigma$ can be corrected with the help of the isotopic relations and satisfactory values obtained. There is at present, however, no way to obtain very accurate values of the vibrational constants for any state of the hydrogen molecule. The H_2 constants of all the states concerned have been recalculated and from the comparison of the three isotopic molecules much can be learned about the reliability of the constants and other properties of the states. $3d^1\Pi^-$ is strongly decoupled but free from prominent perturbations, whereas $3d^1\Sigma$ and $3d^1\Pi^+$ are strongly perturbed. AUTHORS.

4067. Term Schemes for Carbon Monoxide. Part II. R. Schmid and L. Gerö. *Zeits. f. Physik,* 106. 3–4. *pp.* 205–211, 1937.—Vibration terms and rotation constants of the $e^3\Sigma^-$ and $I^1\Sigma^-$ states are calculated and discussed. The convergence of the $e^3\Sigma^-$ state corresponds to the atomic combination $C(^3P) + O(^1S)$ whilst the convergence of the $I^1\Sigma^-$ terms suggests the combination $C(^1D) + O(^1D)$. The " K level of CO " observed by Kaplan is attributed to the overlapping of the CO spectrum with the 0,0 bands of the $A^1\Pi \rightarrow X^1\Sigma$ CS-systems. [For Part I see Abstract 2639 (1937).] W. R. A.

4068. Force Constants and Molecular Structure. Part I. H. W. Thompson and J. W. Linnett. *Chem. Soc., J. pp.* 1291–1295, *July,* 1937.—Recent values of the vibration frequencies of the C_3O_2 molecule, determined by Engler and Kohlrausch's Raman spectral measurements, confirm values previously derived [see Abstract 5157 (1936)] from a study of the u.v. absorption spectrum, and strikingly justify the use of the rules of Herzberg and Teller in analysing complex spectra. By a consideration of the vibration frequencies of the molecule and by a choice of a suitable potential-energy function for the vibrations, the force constants of the linkages in the molecule have now been calculated. The values obtained clearly show the existence of a resonance hybrid structure agreeing with previous independent results of Brockway and Pauling. The antisymmetric vibration frequencies of the molecule have also been derived. [See following Abstract.] H. H. Ho.

4069. Force Constants and Molecular Structure. Parts II–VI. H. W. Thompson and J. W. Linnett. *Chem. Soc., J. pp.* 1376–1403, *Aug.,* 1937.—In these papers the authors discuss ethylene, molecules containing $C = O$ and $C = C$ linkages, tetrachloroethylene, and compounds containing the cyanide link. The assignment of nine planar vibration frequencies is discussed and different potential functions explored. The relationship between force constant and bond-length is discussed. [See preceding Abstract.]

4070. Infra-Red Absorption Spectrum of Carbon Suboxide. R. C. Lord, Jr. and N. Wright. *J. Chem. Phys.* 5. *pp.* 642–649, *Aug.,* 1937.—The infra-red absorption spectrum of carbon suboxide vapour has been studied under low dispersion in the region from 2μ to 25μ. The vibrational bands observed may be satisfactorily accounted for on the basis of a linear symmetric structure for the carbon suboxide molecule, in agreement with evidence obtained from Raman spectra and from electron diffraction investigations. AUTHORS.

4071. Ultra-Violet Spectra of BeH and BeH⁺. W. W. Watson and R. F. Humphreys. *Phys. Rev.* 52. *pp.* 318–321, *Aug.* 15, 1937.—A BeH band system analogous to the $B^2\Pi \rightarrow X^2\Sigma$ MgH system is reported. Observed bands are the (0, 0) at 1960, (1, 0) at 1882 and (1, 1) at 1956 Å. Each consists of a single Q branch (negligible spin doubling), P- and R-branch transitions being eliminated by predissociation from the $^2\Pi$ state into a neighbouring unstable $^2\Sigma$ state. For the $^2\Pi$ state $B_0 = 10{\cdot}65$ cm^{-1}. and $\omega_e - 2x_e\omega_e = 2133{\cdot}4$. The complex BeH spectrum from 3100 to 3600 Å consists only of an extension of the known $^1\Sigma^+ \rightarrow {}^1\Sigma^+$ BeH$^+$ system. Analyses of the principal BeH$^+$ bands in this region yield revised values for the band constants. AUTHORS.

4072. Internuclear Distance in Oxygen Molecules. H. D. Babcock. *Nat. Acad. Sci., Proc.* 23. *pp.* 301–304, *June,* 1937.—The assumption that the difference in moment of inertia of two isotopic molecules is due almost entirely to the difference of reduced mass (owing to the presumed constancy of the extranuclear electric field) is examined in the light of data obtained from measurements of twelve absorption bands of atmospheric O_2. Eight of these bands are associated with the ordinary molecule $O^{16}O^{16}$, and two each the isotopic molecules $O^{16}O^{17}$ and $O^{16}O^{18}$. With the exception of one band ($^3\Sigma \leftarrow {}^1\Delta$) the transition in every case is $^3\Sigma \leftarrow {}^1\Sigma$. Molecular constants are obtained in the usual fashion and it is found that the internuclear distances for $O^{16}O^{16}$ and $O^{16}O^{18}$ in the $^3\Sigma$ state are the same to about one part in 50,000, but there is a decrease for the heavier molecule in the $^1\Sigma$ state of four parts in 10,000. It is found also that the auxiliary constant a differs slightly from one kind of molecule to another. A. H.

4073. Vibration-Rotation Energy Levels of Polyatomic Molecules. Part III. Effect of Centrifugal Distortion. E. B. Wilson, Jr. *J. Chem. Phys.* 5. *pp.* 617–620, *Aug.*, 1937.—The effect of the centrifugal distortion on the individual rotational energy levels of semi-rigid asymmetrical rotator molecules is calculated by an approximate quantum-mechanical treatment. A secular equation is obtained which reduces to the Wang equation when the molecule is rigid and which can be factored to the same extent as the Wang equation. It is shown that the numerical coefficients which occur are identical with those which enter the classical treatment of this problem, if the assumption is made that the vibrational wave functions are harmonic oscillator functions. [For Parts I and II see Abstracts 2745 and 2746 (1936).] AUTHOR.

4074. Semi-Rigid Water-Type Rotator. B. L. Crawford, Jr. and P. C. Cross. *J. Chem. Phys.* 5. *pp.* 621–625, *Aug.*, 1937.—The necessary numerical coefficients of the molecular constants in the secular equation obtained in the paper by E. B. Wilson [see preceding Abstract] are tabulated up to $j = 12$. A rapid approximate procedure for obtaining the roots of the secular equation is described. The treatment is applied to the H_2S band at 10,100 Å. A slight improvement is obtained over the previous analysis which used the Wang equation classically corrected for centrifugal distortion. New molecular constants and term values are given. AUTHORS.

4075. Fluorescence of Acetone Vapour. R. Padmanabhan. *Indian Acad. Sci., Proc.* 5*A*. *p.* 594, *June*, 1937.—Structure is observed in bands previously reported structureless, being most pronounced in the band with maximum at λ5117. A. H.

4076. Visible Fluorescence Band of Cd Vapour. A. Kotecki. *Acta Physica Polonica*, 6. 2. *pp.* 144–149, 1937. *In German.*—Continuing previous work [see Abstract 717 (1937)] the intensity distribution in the visible fluorescence band of Cd vapour is investigated by photometric measurements upon spectra obtained with a spectrograph giving a dispersion of 41 Å per mm. at 4000 Å. It is found that increasing the temperature from 680 to 820° C. causes the intensity of the band to increase on the short wave-length side. Experiments are also carried out to investigate the effect of varying the wave-length of the exciting light, the Cd vapour at 820° C. being irradiated with (i) Cd arc (2749, 2573 and perhaps 2313 Å) and (ii) Mg arc filtered through uviol glass (2800 Å approx.). The effects are relatively small, but the results indicate the fall of intensity towards shorter wave-lengths in the fluorescence band is more rapid for excitation with the longer wave-lengths, the intensity maximum of the band being displaced towards shorter wave-lengths. The ratio of the intensity of the visible band to that of the van der Lingen band is greater for the shorter wave-length excitation, while in both cases this ratio increases with rise of temperature. The results are discussed in relation to the mechanism of excitation. L. A. W.

4077. "Mirror Symmetry" of Fluorescence and Absorption Bands in Solutions. P. Pringsheim. *Acta Physica Polonica*, 6. 2. *pp.* 158–162, 1937. *In German.*—Fluorescence and absorption spectra of aqueous solutions of uranyl sulphate are recorded and discussed. W. R. A.

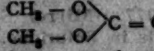
4078. Axial Orientation of the H and He Atoms in an Electric Field and by Beam Collisions. J. Stark. *Phys. Zeits.* 38. *pp.* 572–574, *Aug.* 1, 1937.—Further arguments, based on the Stark effect, are adduced in support of the author's conception of a ring structure for the H and He atoms. [See Abstracts 2767 and 3096–3099 (1937).] C. B. A.

4079. Raman Spectrum and Structure of Water. P. C. Cross, J. Burnham and P. A. Leighton. *Am. Chem. Soc., J.* 59. *pp.* 1134–1147, *June,* 1937.—An investigation of the Raman spectrum of water over a wide temperature range (up to 374° C.) of ice at 0°, and of D_2O, using high dispersion. The results are discussed on the basis of a broken-down ice structure for water. The perturbations of the radial vibration-frequencies of the nine types of coordinated water molecules possible in such a structure are calculated from two experimentally determined constants: Δ, the perturbation of an OH oscillator due to H bonding through its H to another O, and δ, the perturbation of the OH oscillator due to H bonding through its O to the H of another oscillator. The resulting frequency patterns satisfactorily explain the structure and variations with temperature of the main band of ice and water. Semi-quantitative estimates are made of the relative amounts of ten different coordination types of water molecules. An empirical treatment of the perturbing potentials in terms of Morse functions gives the means of estimating intermolecular frequencies, and the results confirm already existing identification of the "hindered translation" and "hindered rotation" frequencies. The energy of the H bond in water is estimated at about 3 k.cal./mol. per bond. A. C. M.

4080. Infra-Red and Raman Spectra of Chlorobromomethanes. J. Lecomte, H. Volkringer and A. Tchakirian. *Comptes Rendus,* 204. *pp.* 1927–1929, *June* 28, 1937.—The spectra of CCl_3Br, $CClBr_3$ and CCl_2Br_2 (preparation and properties recorded) are compared with those of CCl_4 and CBr_4. For all three compounds the required number of fundamentals have been found and several lines due to harmonics and combination tones. W. R. A.

4081. Raman Spectra of Di- and Tri-Carboxylic Acids. J. T. Edsall. *J. Chem. Phys.* 5. *pp.* 508–517, *July,* 1937.—The following di- and tri-carboxylic acids and salts have been investigated: oxalic acid, di-potassium oxalate, malonic acid, mono-sodium malonate, di-sodium malonate, malonic-d_2 acid-d_2 (solution in D_2O), di-sodium malonate-d_2 (solution in D_2O), crotonic acid, sodium crotonate, maleic acid, di-sodium maleate, di-sodium fumarate, *d*-tartaric acid, di-sodium *d*-tartrate, meso-tartaric acid, *l*-aspartic acid hydrochloride, sodium *l*-aspartate, *d*-glutamic acid hydrochloride, sodium *d*-glutamate, tri-carballylic acid, tri-sodium tricarballylate, citric acid, tri-sodium citrate; all examined as solutions in water except where otherwise stated. Certain general conclusions are reached. A. C. M.

4082. Raman Effect and Dipole Moment in Relation to Free Rotation. Part VIII. M. Kubo, Y. Morino, and S. Mizushima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 716. *pp.* 129–137, *July,* 1937. *In English.*—The normal state of dimethyl carbonate can well be approximated by the classical formula



$$\begin{matrix}CH_3-O\\CH_3-O\end{matrix}\!\!>C=O,$$

so that there is no significant single bond-double bond resonance by which the internal configuration is locked rigidly. The molecule can, therefore,

V.4
193

exert internal oscillatory rotations, the amplitude of which is easily affected by the change of temperature, *i.e.*, there is an observable temperature dependence of dipole moment. [For Part VII see Abstract 3611 (1937).] AUTHORS.

4083. Chain Vibrations of Isomeric Paraffins and their Detection in the Raman Spectrum. R. Mecke. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 347–361, 1937.—The valency chain vibrations of normal and branched hydrocarbons have been calculated by means of a model, and thereby the observed Raman-lines in the doubtful frequency region of 700 to 1000 cm^{-1}. have been interpreted. The various isomers of a saturated hydrocarbon can therefore be spectroscopically identified. For different branched types there are especially characteristic intensive Raman lines in the region 700 to 850 cm^{-1}. H. H. Ho.

4084. Polarisation of Raman Lines of Organic Compounds. B. K. Chaudhuri. *Indian Journ. Phys.* 11. *pp.* 203–211, *July*, 1937.—The polarisation of the Raman lines of piperidine, ethylene diamine, diethylamine and triethylamine is investigated and the symmetry of the first two of these molecules is discussed. It is shown that the piperidine molecule has a puckered structure having the symmetry C_{1h} and that probably there is no free rotation about the C—C axis in the molecule of ethylene diamine, though there is such a rotation of each of the NH_2 groups about the C—N bonds. AUTHOR.

4085. Raman Effect in Quartz with Circularly Polarised Light. C. Bouhet. *Comptes Rendus*, 204. *pp.* 1661–1663, *May* 31, 1937.—The Raman effect is observed along the optic axis of a piece of quartz, receiving the light scattered in the direction opposed to that of the incident light. The incident light is circularly polarised, and the scattered light is analysed into regularly and inversely polarised components. It was found that the lines 207, 355 and 465 cm^{-1} were regularly polarised, and the remainder inversely; moreover no difference was observed when right-handed and left-handed pieces of quartz were examined. A. C. M.

***4086. Apparatus for Spectrum Analysis. H. Triché.** *Rev. d'Optique*, 16. *pp.* 161–168, *May*, 1937.—By arranging an electrode of the unknown alloy and one of a known alloy on opposite sides of a thin metal plate (not containing the elements to be examined), a prolongation of which stretches to the spectroscope slit juxtaposed spectra are obtained. Equality of position of the sparks is tested by the illumination of a diffusing screen. A rotating sector is employed, and accuracy of estimation of impurities is from 5% to 10%. H. G. C.

4087. New Methods of Qualitative Spectrum Analysis. Part I. Relative Width of Lines. F. Eisenlohr and K. Alexy. *Zeits. f. phys. Chem.* 179. *Abt.A.* 4. *pp.* 241–255, 1937.—From theoretical considerations it is deduced that the width of spectrum lines is a measure of intensity and examples given of the measurement of this quantity using a spectrum-line-photometer. The method is then applied to the determination of impurities using a spark source and the material in a bead of phosphorous salt. It is claimed that high percentage alloy can be dealt with in this way and that the trouble of oxidation of metal electrodes is avoided. F. S.

***4088. Quantitative Spectrographic Analysis of Biological Material. J. S. Foster and C. A. Horton.** *Roy. Soc., Proc.* 123*B*. *pp.* 422–430, *Aug.* 17, 1937.—An internal standard method of general applicability is developed for quantitative spectrographic analysis of fresh plant tissue without ashing or chemical treatment. The method is applied to the determination of B, line intensities being measured with a wedge. Results obtained for normal plants with 200 mg. of material are reproducible with variations rarely in excess of 10%. A photometer for wedge spectrograms is described. It is designed to avoid the problem of finding the ends of the spectral lines and to give the relative intensities directly. AUTHORS.

See also Abstracts 3817, 3825, 3835, 3836, 3936, 4000, 4009, 4092, 4102, 4118, 4128.

VISION.

4089. Non-Homogeneous Sensations : New Theory of Sensation Discrimination. W. D. Wright. *Brit. J. Psych.* (*Gen. Sect.*), 27. *pp.* 394–398, *April*, 1937.—It is shown that the fundamental problem in sensation discrimination is to find the cause of the finite limit in discriminating power. The theory put forward is based on the assumption that no sensation that we perceive is in reality a homogeneous sensation. The change in stimulus necessary to produce a just noticeable intensity difference is on this theory governed by the variation among the individual elements of the sensation. W. D. W.

4090. Searching for Light Signals of Brief Duration. A. Blondel. *Comptes Rendus*, 204. *pp.* 1769–1773, *June* 14, 1937.—From a consideration of the greater sensitivity to light of the parafoveal compared with the foveal retina, and of the rapidity of eye motions, the author concludes that in searching for flashing light signals the observer should keep his eyes fixated (with the aid of a special fixation point, if necessary) for periods exceeding the dark period between flashes. This dark period should be kept small (not greater than 2 to 3 sec., according to experiments). W. S. S.

4091. Influence of Light Adaptation on Subsequent Dark Adaptation of the Eye. S. Hecht, C. Haig and A. M. Chase. *J. Gen. Physiol.* 20. *pp.* 831–850, *July* 20, 1937.—The adaptation level of a point on the retina situated 30° from the fovea has been measured by a threshold method, during the process of dark adaptation following various intensities of light adaptation. Pre-adaptation to intensities below 200 photons is followed only by rod adaptation, while pre-adaptation to intensities above 4000 photons is followed first by cone adaptation and then by rod adaptation. Rod dark adaptation appears in two types, rapid and delayed. The rapid adaptation occurs after pre-adaptation to low intensities; the delayed rod adaptation occurs after very high intensity light adaptation, and may appear only after 12 or 13 min. in the dark. It is suggested that the two modes of rod dark adaptation may be due to two methods of formation of visual purple in the rods after bleaching. W. D. W.

4092. Absorption Spectra of Visual Purple and of Indicator Yellow. R. J. Lythgoe. *J. Physiol.* 89. *pp.* 331–358, *June* 3, 1937.—A method of preparation of reasonably pure solutions of visual purple is described. Measurements of the absorption curve show that it is practically unaffected by H-ion concentration, and after corrections are made for impurities present, the maximum absorption is found at 502 $m\mu$. During bleaching a well-defined intermediate substance, called "transient orange," is formed. Transient orange is thermally decomposed to a yellow substance, named "indicator yellow." Indicator yellow is pale yellow in alkaline solution, a deeper yellow of the same apparent hue in neutral solution and a deep chrome yellow in acid solution. Absorption curves for indicator yellow have been determined between 395 and 650 mμ over a range of H-ion concentration from pH 3·3 to 10·8. As revealed by their absorption curves the reactions of indicator yellow are completely reversible. W. D. W.

X-RAYS.

4093. Emission of X-Rays by Vacuum Tubes of Small Dimensions. L. Maillet. *Comptes Rendus*, 205. *pp.* 231–234, *July* 19, 1937.—A small X-ray tube for operation by h.f. current is described. With a tube of effective length 5 cm., and dia. 5 mm., and h.f. current corresponding to a wave-length of 200 m. at 40 kV, and emission of 10r./hr. is obtained at a distance of 2·5 cm. from the axis of the tube. The mean wave-length of the radiation is 0·3 Å. The small dimensions of the tube permit their introduction into small spaces, and may therefore have important radiographic applications. C. J. B. C.

***4094. 30 kW Continuous Input X-Ray Equipment and Constant H.V. Generating Plant. J. W. M. DuMond and J. P. Youtz.** *Rev. Sci. Instruments*, 8. *pp.* 291–307, *Aug.*, 1937.—This report describes in detail with photographs and cross-sectional views an X-ray tube with a gyrating water-cooled target which the authors have operated continuously for periods of hours at 287,000 V and 105 mA. The theoretical predictions of DuMond, Watson and Hicks as to the ratio of safe load in moving and fixed targets seems to be roughly fulfilled by these results. The computed power output in the form of X-rays alone is some 3/4 kW. The report further describes in detail the power supply equipment consisting of a synchronous motor driven 40 kW motor generator set giving 150-cycle current both half-waves of which, after transformation of high voltage, are rectified by two thermionic valves (filament emission 2A maximum) of our own design and construction here fully described. The powerful electrical filter system to reduce the ripple to a low value and some technical problems arising from the large power rating of the equipment as well as the facilities now almost completed for stablising and measuring precisely the high voltage supplies to the X-ray tube are discussed. At the outset a brief indication of the program of research work projected for this set is given. AUTHORS.

4095. Form of Compton Lines. Part I. A. Sommerfeld. *Ann. d. Physik*, 29. 8. *pp.* 715–720, *Aug.*, 1937.—The sharp Compton line produced by a free electron is spread out into a band when the Compton effect is produced by a number of bound electrons in an atom. The discussion in this paper is restricted to the H atom, and it is shown that the Compton band is cut off by a sharp edge on its short wave-length side. This is due to the finite value of the energy required to remove the electron from the atom. The various positions that this edge might occupy in the band are derived by means of a simplified theory. The portion of the band which is cut away by the edge is shown to be replaced by a series of Raman lines, which thus lie between the undisplaced or Rayleigh line and the Compton band. The most favourable conditions for observing these effects are discussed. The experiments of B. B. Ray are reviewed in the light of these new ideas. [See following Abstract.] G. G.

4096. Form of Compton Lines. Part II. W. Franz. *Ann. d. Physik*, 29. 8. *pp.* 721–740, *Aug.*, 1937.—A formula for the Compton spectrum obtained from any arrangement of electrons in an atom is derived. According to this formula the edge cutting off the short wave-length side of the Compton band [see preceding Abstract] must be observable in a series of light elements, the rare gases and copper. For most favourable conditions, however, observations will have to be made at very small angles. The calculations in the formula refer to free atoms, though it is to be expected that similar relations hold for crystalline materials, if the crystal layers are not too thick. There are uncertainties in the intensity formula which become more marked for heavy atoms. It is suggested that by a comparison of the ratios of intensities observed at various angles, with those given by theory an understanding of the heavier atoms might be obtained. G. G.

4097. Colouring of Glass by X-Rays. C. E. Nurnberger and R. Livingston. *J. Phys. Chem.* 41. *pp.* 691–697, *May*, 1937.—A new experimental study of the kinetics of the colouring of glass by X-rays is presented, and a general theory of the process is suggested and adjusted to the measurements. In the present study, emphasis is placed upon the relation between the saturation colour and the intensity of the absorbed X-rays, the homogeneity of colour in thick plates, and the effect of intensity of X-rays on the spectral distribution of colour. [See also Abstract 5072 (1935).] AUTHORS.

4098. L-Emission and Absorption Spectra of Radium (88). H. Hulubei. *J. de Physique et le Radium*, 8. *pp.* 260–266, *June*, 1937.—Very little is known of the X-ray spectrum of Ra. An account is now given of a study of the L-spectrum. A few hundredths of 1 mg. of Ra is sufficient to obtain, by kathode excitation, all the dipole lines and the principal quadripole lines. To record all the weakest emissions the time of exposure does not exceed an hour. Under these conditions the radiations from the small quantity of Ra used do not affect the photographic plate. More than 40 emission lines are measured. In the absorption spectrum the frequencies of the 3 discontinuities and of two white absorption lines (L_{III} and L_{II}) are determined. The energies of the different electronic levels are computed from the frequency of the L_{III} discontinuity and the frequencies of the emission lines. C. J. B. C.

4099. L-Emission and Absorption Spectra of Rhenium. Yvette Cauchois. *J. de Physique et le Radium*, 8. *pp.* 267–272, *June*, 1937.—The L-emission and absorption spectra of Re are studied with a focussing transmission spectrograph. The experimental arrangement and conditions of operation are given. The wave-lengths of a large number of weak lines are measured, as well as those of the intense lines previously found. Taking the frequencies of the strong lines and a value $\nu/R = 775 \cdot 79$ for the L_{III} absorption discontinuity, the energy levels of the Re atom have been determined with precision. C. J. B. C.

4100. Precision Determination of the Lattice Constant of Quartz and New Measurement of the Kα Wave-Lengths of Rh, Pd and Ag. S. Elg. *Zeits. f. Physik*, 106. 5–6. *pp.* 315–321, 1937.—Using the precision method described by Larsson [see Abstract 2547 (1927)] the lattice constant of quartz (plane 0001) is determined in the first three orders with Mo Kα. The value $d = 1 \cdot 797872$ Å is obtained, the error being estimated as $\pm 0 \cdot 00002$ Å. Wave-lengths are also measured for the Kα_1 and Kα_2 lines of the elements 45Rh, 46Pd and 47Ag in the first two orders. Finally the values of the refractive index of quartz for these wave-lengths are given. L. A. W.

See also Abstracts 3827, 3857, 3864, 3998.

HEAT.

CALORIMETRY.

4101. Thermal Data of Ethylene. C. J. Egan and J. D. Kemp. *Am. Chem. Soc., J.* 59. *pp.* 1264–1268, *July*, 1937.—Specially purified ethylene, in which the impurity was estimated to be less than 0·001 mol. % was used in these measurements. The vapour pressure P of ethylene at a temperature T° K. is given by $\log_{10} P = -(962 \cdot 794/T) + 9 \cdot 80431 - 0 \cdot 0184522\, T + 0 \cdot 000030870\, T^2$ for a temperature range of 123° K. to 170° K. The boiling point is 169·40 ± 0·05° K. and the melting point is 103·95 ± 0·05° K. The latent heat of fusion was found to be 800·8 ± 0·8 cal./mol. and the latent heat of vaporisation to be 3237 ± 3 cal./mol. The thermal capacity of ethylene at various temperatures is also given in the form of a curve and a table of figures. The entropy is calculated from these data and found to be 47·36 cal./deg./mol. at 1 atmos. and 169·40° K. whilst a calculation of the entropy from spectroscopic data gives 47·35 cal./deg./mol. G. G.

4102. Latent Heats of Vaporisation of CdSe, HgSe and ZnTe from the Absorption Spectra of their Vapours. L. S. Mathur. *Indian Journ. Phys.* 11. *pp.* 177–185, *July*, 1937.—From the absorption spectra of selenides of Cd and Hg and the telluride of Zn, their heats of sublimation are calculated with the help of Born's cycle. Latent heats of vaporisation for CdSe, HgSe, and ZnTe are found to be 39·40, 83·23 and 61·78 respectively. The difference in the long wave-length limits of continuous absorptions for these compounds is found to be greater than the atomic term difference $3P - {}^1D$ of the electronegative element. This discrepancy is explained with the help of Franck-Condon diagrams. AUTHOR.

CONDUCTION.

4103. Thermal Conductivity of KBr, KCl and SiO_2 at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. No.* 249*a*. *Physica*, 4. *pp.* 752–756, *Aug.*, 1937. *In English.* —The thermal resistance of crystals of KBr and KCl is investigated in the region of liquid He. Both crystals show an increase of thermal resistance as in the case of quartz, the rise, however, being much smaller than in that case. Remarkable is the fact that the resistance of quartz, which diminishes rapidly from 90° K. down to 10° K. to 1/40 of the value at 90° K., again shows a very strong increase, while the resistance of the salts, which diminishes only to about 1/10 of the value at 90° K., has a much smaller increase. [See also Abstract 3553 (1935).] AUTHORS.

4104. Anisotropy of Thermal Conductivity and Thermal E.M.F. of Tungsten in Transverse Magnetic Field at 20° K. E. Grüneisen and H. Adenstedt. *Ann. d. Physik*, 29. 7. *pp.* 597–604, *Aug.*, 1937.—The following results are obtained for the effect of a transverse magnetic field on a pure W crystal at 21·8° K. :—A field strength of 6100 Oe causes the conductivity to decrease to ¼ of its initial value; variations of 25 % are found as this field is turned in a plane perpendicular to the rod; these variations are similar to those found by Justi and

Scheffers for electrical conductivity; extrapolation indicates that further increase in field strength should finally lead to a reduction in thermal conductivity to a constant value of 5 to 6 W/cm.°C., which value is considered to represent the thermal conductivity of the crystal lattice. The field of 6100 Oe produces a change in thermal e.m.f. varying from 1·01 to 2·22 μV/°C. according to the direction of the transverse field. R. W. P.

See also Abstracts **3802, 3965.**

CONVECTION.

4105. Coefficient of Heat Transfer for Vertical Surfaces in Still Air. R. Ruedy. *Canad. J. of Research*, 15. *Sect. A. pp.* 109–117, *July*, 1937.—For a vertical plane surface in still air the coefficient of heat transfer, valid within the range of temperatures occurring in buildings, depends on the temperature and the height of the surface. If black-body conditions are assumed for the heat lost by radiation, the coefficient is equal to 1·39, 1·50, 1·62 and 1·73 B.Th.U. per $ft.^2$ per °F. at 32°, 50°, 68° and 86° F. respectively, the height of the heated surfaces being 100 cm. Convection is responsible for about one-third, and radiation, mainly in the region of 10 microns, for about two-thirds of the heat loss. Convection currents depend on the temperature difference, while radiation depends on the average temperature. When attempts are made to stop convection currents by placing obstacles across the surface, the loss of heat due to natural convection varies inversely as the fourth root of the height, providing that the nature of the flow of air remains unchanged. AUTHOR.

4106. Instability of a Spherical Shell of Fluid Heated from Within. R. J. Schmidt. *Phil. Mag.* **24.** *pp.* 228–239, *Aug.*, 1937.—The equations of disturbed motion, symmetrical about an axis, are given, and the marginal stability criterion is determined approximately by the use of polynomials which satisfy the boundary conditions contemplated. It has been suggested that the motion ensuing from the instability of such a layer occurs in the sun, but the results of this paper give a layer far too thin to fit in with the vortex theory of sunspots. W. G. B.

DILATATION.

See Abstract **3888.**

MELTING AND BOILING POINTS.

4107. Constitution and Electrical Conductivity of Cs-Rb Alloys. E. Rinck. *Comptes Rendus*, 205. *pp.* 135–137, *July* 12, 1937.—The investigation is part of a systematic study of alkali metal systems [see Abstract 4273 (1936)]. Pure Cs (m. pt. 28·4° C.) and Rb (m. pt. 38·85° C.) are obtained by reduction of the clorides with Ca, followed by double distillation *in vacuo*. The Cs-Rb liquidus and solidus are smooth U curves with coincident minima at 9° C., at composition corresponding to Rb : Cs. The (liquid + solid) interval is small—about 3° C. At 0° and at −39°, the electrical conductivity shows the smooth U curve, characteristic of solid solutions, with minimum also at Rb : Cs, but there is no evidence of compound formation. All experiments are carried out *in vacuo*. The results obtained are in strong contradiction to those of Goria [*Gaz. Chim. Ital.* 65. *p.* 1226, 1935] who worked in an inert gas atmosphere. It is suggested that the eutectic observed by him at −39° C. was a ternary or quaternary mixture Cs–Rb–O–H. D. R. H.

4108. Intensity of Orbital Interaction in Multiply-Ionised Compounds. R. Forrer. *Comptes Rendus*, 204. *pp.* 1717–1719, *June* 7, 1937.—In fusible and transition metals the solid crystalline state (stable up to the melting-point, T) is governed by the orbital electronic arrangement. If N is the number of interactions between an atom and its neighbours and F is a factor which is a measure of the intensity of the interaction between the electronic orbits, then $T = F\sqrt{N}$. F is not constant but depends on a number of factors which are enumerated. A table is compiled which shows the degree of ionisation *i*, the absolute temperature of fusion T and N (= 12) for a series of fluorides, oxides, nitrides and carbides, from which it is evident that $T \propto i$; hence it is concluded that the orbital interaction in multiply-ionised compounds is proportional to the degree of ionisation. [See Abstract 3653 (1397).] H. J. H. S.

4109. Relation between Atomic Radii and Boiling Points. Chu-Yao Chen, Chao-Lun Tseng and Cheng E. Sun. *Chinese Chem. Soc., J.* 5. *pp.* 193–201, *July*, 1937.—In a previous paper [see Abstract 4274 (1936)] boiling points were estimated from critical temperatures and pressures which give better agreement with experiment than a number of empirical formulæ found in the literature. From the nature of the $T_b - V_m$ graph (where T_b is the boiling temperature and V_m is the molecular volume, *i.e.*, the product of the number of atoms and the cube of the atomic radius) the following equation is now proposed, viz.: $T_b = a + bV_m + cV_m^2$, where *a*, *b*, *c* are constants evaluated by the method of least squares. The results of calculations of the boiling points of members of 13 homologous series, including 128 organic compounds, are now listed and show excellent agreement with experiment, except the first two members of each series which usually show irregularity in physical properties. H. H. Ho.

***4110. Production of Liquid Hydrogen without Expensive Equipment. F. G. Keyes, H. T. Gerry and J. F. G. Hicks, Jr.** *Am. Chem. Soc., J.* 59. *pp.* 1426–1437, *Aug.*, 1937.—A H_2 liquefying system which depends upon commercial electrolytic H_2 as the source of high pressure gas is described. This involves the use of metal dewars, improved means of thermal isolation and heat exchange, and a means for producing lower fore-temperatures in the form of a charcoal desorption unit. The theory and economy of H_2 liquefaction are discussed. AUTHORS.

See also Abstract 4101.

TEMPERATURE, MEASUREMENT OF.

***4111. Properties of Radiation Receivers with Special Reference to Thermoelements. H. Theissing.** *Phys. Zeits.* 38. *pp.* 557–564, *Aug.* 1, 1937.—With regard to the importance of radiation thermoelements, particularly for spectral energy measurements, a comparison is made of their sensitivity with that of other types of radiation receivers. With vacuum thermoelements the need for good galvanometers having steady zeros and giving reproducible deflections is emphasised. Reference is also made to the avoidance of possible errors which can arise owing to the non-uniform sensitivity of the thermo-strip. R. W. P.

See also Abstract 4121.

THERMOCHEMISTRY.

4112. Heats of Dilution of Salts in D_2O and H_2O. W. Birnthaler and E. Lange. *Zeit. f. Elektrochem.* 43. *pp.* 643–659; *Disc.*, 659, *Aug.*, 1937.—Because of the existence of an isotope effect in the heats of solution, a similar effect was looked for in the heats of dilution of NaCl, KBr, KF, $Ba(NO_3)_2$, $CuSO_4$ and $BeSO_4$ in D_2O and H_2O. Experimental methods and a measure of the effect—denoted by $\mathrm{I}\ V_m$—are described. The effect is found to be as large as 20% of the heats of dilution themselves. Three different ranges of concentration could be distinguished. For low concentrations, no effect was observed; this is interpreted to mean that the dielectric constants of D_2O and H_2O have the same temperature coefficient. For medium concentrations $\mathrm{I}\ V_m < 0$ but gradually increases to larger negative values. For high concentrations of KF, the differential of the effect is found to be practically independent of concentration; this seems to be in agreement with other properties of highly concentrated solutions and is regarded as corresponding to a kind of saturation of the dipoles of the D_2O and the H_2O molecules. G. G.

4113. Flame Propagation in Nitric Anhydride-Ozone. T. M. Lowry and R. V. Seddon. *Chem. Soc., J. pp.* 1461–1468, *Aug.*, 1937.—Mixtures of N_2O_5, O_3 and O_2 were ignited in a long reaction tube, and the time required for the flame to travel along a column 90 cm. long, maintained at a constant temperature, was measured. The speed of the flame is extremely sensitive to changes of conditions; *e.g.*, (*a*) the concentrations of anhydride and ozone and the " age " of the mixtures; (*b*) the temperature of the tube and the total pressure; (*c*) the diameter of the tube and its horizontal or vertical position; (*d*) the nature and concentration of the inert gas. The flame is propagated by the diffusion of " hot " molecules from the flame-front into the unburnt gas causing activation and further reaction. AUTHORS.

4114. Low-Temperature Transformation. A. Debierne. *Comptes Rendus*, 205. *pp.* 141–143, *July* 12, 1937.—When He or H_2 (and to a somewhat less extent Ne) first comes into contact with C at −195° there is a great evolution of heat, in the case of He, for the first few seconds, at the rate of 10^8 cal./gm., but very rapidly decreasing. Allotropic change in the C, or chemical change in some impurity therein seeming improbable, it is suggested that it may be due to some nuclear reaction, though no certain evidence of this in the shape of ionising radiations was detected with a counter in the case of He, and only very slight conductivity in the gas after it came in contact with the C. C. A. S.

See also Abstracts 3816, 4065.

THERMODYNAMICS.

4115. Theorem of Corresponding States and the Equation of the Rectilinear Diameter. T. Pinter. *Zeits. f. Elektrochem.* 43. *pp.* 669–681, *Aug.*, 1937.—In this paper the univariant system liquid-saturated vapour for which the equation of the rectilinear diameter is valid is considered as a unit, and characteristic relationships are derived for the density D, its reciprocal 1/D = F, and the expansion coefficient (1/F) (*d*F/*d*T). It is explained that the usual form of the reduced equation for the rectilinear diameter is not to be regarded as a true reduced equation and another form is given, viz.: $\frac{1}{2}(\delta_{\mathrm{liq.}} + \delta_{\mathrm{vap.}}) = (c - d)/(c - 1)$, where the quasi-universal constant c is a pure number. From a consideration of the expansion coefficient, c is found to be 2. For temperatures remote from the critical, the expansion coefficient $= 1/(cT_b - T)$ where c decreases with increasing temperature. Also $S/S_0 = (cT_b - T)/(cT_b - T_0)$, where S and S_0 are the densities of the liquid phase at T and T_0 respectively. In Mendeléef's equation for the modulus of expansion, the constant $K = 1/(cT_b - T_0)$, and Walden's equation is found to be more valid as $Kt_b = t_b/(2T_b - 273)$. A formula for calculating the density at absolute zero is given without requiring a knowledge of the values for d_b and T_b. Values for b, c, K, d_b and T_b are calculated for 30 of the liquids investigated by Young. The critical temperature of Hg is found to be 1463° C. for a critical density of 5. All liquids are divided into 3 classes, viz. normal where $c = 2$, anomalous or associated where $c > 2$, and those in which $c < 2$. H. H. Ho.

4116. Second Virial Coefficient of Argon. K. F. Herzfeld. *Phys. Rev.* 52. *p.* 374, *Aug.* 15, 1937.—The second virial coefficient is calculated from the energy expression obtained for frozen argon. AUTHOR.

4117. Calculation of the Specific Heats of Liquids. G. Racah. *Accad. Lincei, Atti*, 25. *pp.* 481–484, *May* 8, 1937.—A rapid method of calculating an approximate value of the specific heat of a liquid is given. An equation for the specific heat in terms of the Trouton-Hildebrand constant and the coefficient of association of the liquid at the boiling point is derived, and the numerical values computed by taking mean values of these two constants. It is observed that the Trouton-Hildebrand constant may be interpreted as a molecular specific heat. C. J. B. C.

4118. Heat Capacities of Benzene and Benzene-d_6. R. C. Lord, Jr., J. E. Ahlberg and D. H. Andrews. *J. Chem. Phys.* 5. *pp.* 649–654, *Aug.*, 1937.—The heat capacity curve for solid benzene has been computed with the help of the set of internal frequencies previously proposed by Lord and Andrews [see Abstract 1889 (1937)]. The agreement with experiment is satisfactory over the entire temperature range in which the internal frequencies contribute, indicating that the frequency values are essentially correct. A prediction of the heat capacity of benzene-d_6 has also been made. AUTHORS.

4119. Phenomenological Interpretation of the Thermodynamical Constants. V. Njegovan. *Acta Physica Polonica*, 6. 2. *pp.* 109–124, 1937. *In German.*—It is shown that the internal pressure, as well as the inner effect, must be considered for the complete phenomenological interpretation of the thermodynamical constants. In the usual formula for the entropy constant of gases, i_0 is replaced by $i_0 = \log \Pi_0$, where Π_0 is the internal pressure of the (supercooled) gas at $T = 0$. The entropy of the (supercooled) gas has zero value at $T = 0$. The Clapeyron-Clausius equation is only a special form of the Helmholtz equation for the special case of equilibrium ($F = 0$). The vapour pressure constant is determined by means of the formula :

$$i_{vap} = i_0 + \log (P_{liq.}/P^0_{liq.}) + (1/2 \cdot 3RT) \int_0^{Cp^1} T\,d\,Cp^1 - (1/2 \cdot 3RT) \int_0^{C^1_{liq.}} T\,d\,C^1_{liq.},$$

where $P_{liq.}$ denotes the internal pressure of the liquid. For the affinity constant the terms $\log (P_{liq.}/P^0_{liq.})$ and $(1/2 \cdot 3RT) \int_0^{C^1_{liq.}} T\,d\,C^1_{liq.}$ are omitted since they refer to the standard substance. The paper is mathematical throughout. H. H. Ho.

4120. Temperature Variation of Thermodynamic Quantities. G. M. Murphy. *J. Chem. Phys.* 5. *pp.* 637–641, *Aug.*, 1937.—The quantity, $(F^0 - E_0^0)/T$, calculated from spectroscopic data has been fitted to a 5-constant equation in T for 19 molecules. It may be differentiated and integrated to give values of S^0, E^0, H^0 and C_p^0 between 298·1 and 3000° K. and is sufficiently exact for most purposes. The equilibrium constant for exchange reactions involving isotopes has been calculated and in each case, maxima exist and in one case a minimum also. This effect probably occurs at some temperature for all reactions involving isotopic molecules although not for other equilibria. An optimum temperature, therefore, exists for separation of isotopes by exchange reactions. AUTHOR.

4121. Temperature in Relation to Quantal Phenomena. J. Larmor. *Cambridge Phil. Soc., Proc.* 33. *pp.* 340–343, *July*, 1937.—Arising from a development of a modern view of the Carnot-Kelvin aspect of thermodynamics in relation to Maxwell's theoretical investigations of the electro-dynamic field, the problem of temperature, as a unique property of matter in bulk, with its trend to uniformity, is discussed, with special reference to the transition from one temperature to another, from the aspect of dynamical analogy, and is linked up with Bohr's provisional spectral hypotheses and successive steady states, and hence to the quantum. N. M. B.

See also Abstracts 3844, 3924, 4101, 4109.

VAPOUR PRESSURE.

4122. Vapour Pressures of Saturated Gaseous Hydrocarbons at Low Temperatures. R. Delaplace. *Comptes Rendus*, 204. *pp.* 1940–1941, *June* 28, 1937.—The vapour pressures of CH_4, C_2H_6, C_3H_8, *n*- and *iso*-C_4H_{10} are determined in presence of silica gel for numerous temperatures between − 171° and − 135°, − 122° and − 65°, − 95° and − 40° and − 75° and − 25° respectively. The results show that it is easy in this way to separate CH_4 from C_2H_6, C_2H_6 from C_3H_8 and C_3H_8 from C_4H_{10}, but not *n*- from *iso*-C_4H_{10}. H_2 is similarly separable from any of these hydrocarbons in presence of silica gel at − 192°. C. A. S.

4123. Experimental Verification of Thomson's Formula. K. S. Ljalikov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 15. 6–7. *pp.* 327–330, 1937. *In French.*—Thomson's formula for the dependence of vapour pressure on the curvature of a surface is verified from observations of the rate of growth of AgBr crystals during recrystallisation. Surfaces having a diameter of the order of a micron are examined micro-photographically under a magnification of 500. R. W. P.

4124. Deviations of CCl_4 and $SiCl_4$ Solutions from Raoult's Law. S. E. Wood. *Am. Chem. Soc., J.* 59. *pp.* 1510–1514, *Aug.*, 1937.—The vapour pressures and fugacities at 25° of the system CCl_4 and $SiCl_4$ are measured and the deviations from Raoult's law are calculated. It is found that the deviations are all positive but are smaller than those calculated from the equation derived by Hildebrand and Wood. The excess entropy of mixing is calculated making use of heat of mixing data. AUTHOR.

See also Abstract 4101.

ACOUSTICS.

4125. Eddy Formation behind Circular Cylinders and Flat Plates. R. Lehnert. *Phys. Zeits.* 38. *pp.* 476–498, *July* 15, 1937.—The frequency of the notes generated by wires and flat plates when exposed to an air current is measured under various conditions. The obstacles are mounted on a specially designed carriage which enables the resistance to air flow to be determined. The frequency measurements are made by listening with a probe tube and also, in the case of notes generated by a wire, by obtaining the resonance frequency of the wire. In the case of plates at right angles to the air flow, the resistance can be calculated as a function of Reynolds number from the frequency of the note and the spacing of the eddies, according to the theory of v. Kármán. The author finds that the calculated and measured resistance curves have similar trends, but the calculated values are 20 % less than the measured. The case where the air flow is not perpendicular to the obstacle is also examined. K. M. C.

4126. Theory of Wire-Gauze Tones (Thermally Excited Sound Vibrations). K. O. Lehmann. *Ann. d. Physik,* 29. 6. *pp.* 527–555, *July,* 1937.—The Rayleigh theory of the Rijke tube does not agree with experiment. According to hypothesis the intensity of the vibration should increase with the speed of the air current, but experiment shows that the loudness of the sound has a sharp maximum for a definite air speed. The magnitude and phase of the sound impulses were calculated and measured. It is explained how this was done by means of externally applied sound impulses. The theoretical values were much smaller than those found from experiment. Further, in theory the phase angle between impulse and sound pressure diminishes as the intensity increases. In experiment the reverse effect was found. The sound impulse due to heat given off by convection from the gauze contains an active component due to the asymmetry produced by the gauze, and also a strong " blind " component. On these facts a theory is developed which is capable of explaining the Rijke effect. G. E. A.

4127. Production of Plane Sound Waves in Liquids and Demonstration of Fresnel Diffraction Effects. R. Bär. *Helv. Phys. Acta,* 10. 4. *pp.* 311–322, 1937. *In German.*—A quartz plate was investigated with an outline ground, according to Straubel, so that the quartz gave the purest possible depth vibrations. The wave-form was tested for the fundamental at 440 kc./s. and for most of the overtones up to the 25th at 11,000 kc./s. The quartz emitted very nearly plane waves for the higher overtones between 5000 and 10,000 kc./s. An indirect proof of this was supplied by the fact that the Fresnel diffraction effects, seen when plane waves are employed, were well produced by this quartz. Photos of the diffraction effects are given for the range 4000 to 6500 kc./s. in xylol and paraffin oil, namely diffraction at a straight edge, at a wide and narrow slit, at two narrow slits, the Lloyd mirror effect, and diffraction past a thin and a thick cylinder. G. E. A.

4128. Diffraction of Light by Supersonic Waves. P. H. van Cittert. *Physica,* 4. *pp.* 590–594, *July,* 1937. *In German.*—A system of simultaneous differential equations for light dispersion by supersonic waves is deduced, which leads directly to the Raman-Nath or to the Extermann-Wannier solution. J. J. S.

4129. Dependence of Hearing Impairment on Sound Intensity. J. C. Steinberg and M. B. Gardner. *Acoustical Soc. of America, J.* 9. *pp.* 11–23, *July*, 1937.—This paper discusses the measurement of hearing loss for levels of sound well above the deafened threshold and, hence, audible to the deafened person. In the tests, observers having unilateral deafness, *i.e.*, one impaired and one normal ear, balanced a tone heard with the deafened ear against the tone heard with the normal ear. For some people, the impaired ear heard less well than the normal ear for all sound levels. For others, tones which were well above the deafened threshold were heard equally well with either ear. In other words, such deafened ears tended to hear loud sound with normal loudness. This type of deafness can be represented quantitatively on the assumption that it is due to nerve atrophy. Loudness judgments for a normal ear in the presence of noise are found to be similar to judgments by a nerve deafened ear. Relations, based on the loudness properties of normal ears, are extended to represent the loudness heard by deafened ears. AUTHORS.

4130. Investigation of Subjective Tones by Means of the Steady-Tone Phase Effect. J. D. Trimmer and F. A. Firestone. *Acoustical Soc. of America, J.* 9. *pp.* 24–29, *July*, 1937.—Two strong pure tones, of frequencies in harmonic relation, when heard together have a sound depending in loudness and quality on the phase relation between the tones. This dependence may be observed either by the method of beats or by the method of steady tones. The phase effect is closely linked with pitch perceptions, contrary to Ohm's law of acoustics, with subjective tones, and, in general, with the nonlinearity of the ear, *i.e.*, the way the ear responds to sounds of large amplitude. A careful quantitative study of the steady-tone phase effect was made with frequencies up to 500~. The results indicate a need for important revisions in the concept of aural non-linearity. These revisions are summarised in the proposal of a definition, for the term "subjective tone." AUTHORS.

***4131. Chromatic Stroboscope. O. L. Railsback.** *Acoustical Soc. of America, J.* 9. *pp.* 37–42, *July*, 1937.—A stroboscope is described which permits direct reading of any pitch with a precision greater than that of the ear. The readings are made in terms of musical scale notation instead of frequency. AUTHOR.

4132. Empirical Formula for Loudness of a 1000-Cycle Tone. H. P. Knauss. *Acoustical Soc. of America. J.* 9. *pp.* 45–46, *July*, 1937.—The equation $L = I\,(10^{-5/2}\,I + 1)^{-2/3}$ may be used to compute the loudness, L (millisones), of a 1000-cycle pure tone of intensity I (in units of 10^{-16} W/cm^2.). This indicates that for low intensities the loudness is directly proportional to the intensity; for high intensities it is proportional to the cube root of the intensity. AUTHOR.

4133. American Tentative Standard Acoustical Terminology. H. A. Frederick. *Acoustical Soc. of America, J.* 9. *pp.* 60–71, *July*, 1937.

See also Abstracts 4004, 4089.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***4134. New A.C. Bridge. H. J. Mau.** *Arch. f. Elektrot.* 31. *pp.* 473–487, *July* 20, 1937.—After reviewing the principle of the a.c. bridge, particularly the Schering bridge for dielectric loss measurements, the author describes a new four-condenser bridge for this purpose. Details of the screening arrangements, the construction of the condensers and of the sources of error are given, and the results of some actual measurements are included. E. O. T.

4135. New Theorem on Electrical Networks. B. van der Pol. *Physica,* 4. *pp.* 585–589, *July,* 1937. *In English.*—A theorem is given based on a remark of very general validity made by Heaviside in his *Electrical Papers.* If a constant e.m.f. of amount unity is suddenly applied to an arbitrary network originally at rest, the excess of the electric energy over the magnetic energy in the final steady state equals numerically half the differential of the admittance with respect to $j\omega$ at the frequency $\omega = 0$. Deductions from this are the following: (1) The ratio of twice the excess of the magnetic energy over the electric energy to the heat dissipation per sec., all in the final steady state, equals the differential of the logarithm of the impedance with respect to $j\omega$ at the frequency $\omega = 0$. (2) The efficiency with which a battery can be made to charge a system of condensers (any resistances and inductances being in the circuit) is always 50%. J. J. S.

CONDUCTION AND DISCHARGE IN GASES.

4136. Collector Theory for Ions with Maxwellian and Drift Velocities. A. H. Heatley. *Phys. Rev.* 52. *pp.* 235–238, *Aug.* 1, 1937.—For a gaseous discharge in which the ions have a drift velocity superimposed on a Maxwellian distribution, the Mott-Smith and Langmuir collector theory deals only with collectors having a high ratio of sheath to collector diameters. The present paper removes this restriction, but points out that except when there is negligible sheath distortion due to low drift velocity or to low collector potential the theory gives only approximate results. It is also shown that for ratios of drift to random current density as low as seven, the space potential is not indicated by a break on the semi-logarithmic plot of the collector characteristic. AUTHOR.

4137. Gradient in High-Pressure Discharge in Metal Vapours. W. Elenbaas. *Physica,* 4. *pp.* 747–751, *Aug.,* 1937. *In German.*—The gradient in the high-pressure Cd- and Zn-discharge is measured as a function of the diameter of the tube *d*, the amount of metal vapour per cm. of arc length *m* and the energy input per cm. of length *L*, and compared with previous measurements of the gradient in the high-pressure Hg discharge. The gradients in the three vapours can be described by *one* formula in which the constants have different values for the different vapours. Furthermore, the ratios of these constants for the three vapours are near the expected ones. AUTHOR.

4138. Breakdown of Vacuum Spark-Gaps. R. C. Mason. *Phys. Rev.* 52. *pp.* 126–127, *July* 15, 1937.—Experiments with vacuum spark-gaps show that the critical kathode field required for breakdown is not reduced by considerable thermionic emission from the kathode. It is concluded that positive ion emission from the anode under electron bombardment, which apparently enters at higher voltages, is not a factor up to 50 kV. AUTHOR.

4139. Space-Charge and Ionic Effects on Electric Breakdown. W. Rogowski and A. Wallraff. *Zeits. f. Physik*, 106. 3–4. *pp.* 212–229, 1937.—For large sparking distances and pressures space-charge effects are observed, but, in general, the sparking voltage depends on the ionising effect of positive ions. This is the case for air at atmospheric pressure and for voltages up to 100 kV. The subject is treated theoretically and a method of distinguishing between space-charge and ionic effects is deduced; if space-charge effects only are operative the fall in the sparking voltages by weak irradiation is logarithmic over a certain range of conditions. Under ionic conditions the behaviour with weak and strong irradiation is different and certain principles are summarised and discussed. [See also Abstract 2816 (1936).] H. J. H. S.

4140. Recombination of Ions in Air at High Pressure. P. Kraus. *Ann. d. Physik*, 29. 6. *pp.* 449–472, *July*, 1937.—Using a spherical high pressure ionisation chamber, the variation of α the recombination coefficient of ions in air is examined over the range 1–140 $kg./cm^2$. The results do not show very marked departures from the $1/p$ law; where deviations occur, they are in approximate, although not exact, agreement with Langevin's formula. F. C. C.

4141. Mercury Arcs in Capillary Tubes. V. Voss. *Phil. Mag.* 24. *pp.* 312–318, *Aug.*, 1937.—In a previous paper [see Abstract 3602 (1935)] an account was given of the features exhibited by a.c. and d.c. Hg arcs maintained in capillary tubes. Further data on the d.c. arcs are now given and these are briefly discussed. A. W.

4142. Discharge in Air. M. Suzuki, T. Nakamura and T. Mikami. *E.T.J.* 1. *pp.* 109–114, *Aug.*, 1937.—The mechanism of the dark discharge between parallel plate electrodes with one plate covered with a sheet of ebonite is studied. After application of voltage, d.c. or a.c., the accumulated charges on the ebonite, as manifested by the production of dust figures, are examined, and it is found that, generally, emission of electrons from the electrode surface is concentrated at a few minute areas. At these points changes in the electrode surface occur, especially if the electrode is left in a moist atmosphere, emission of electrons then taking place more easily. After application of voltage for some time, or production of a spark, the emission becomes more difficult. The electrode does not recover if left in dry air. It is suggested that the cause of easy emission of electrons is an adsorbed water film to which electrons or ions adhere and the electrons are pulled away on application of a sufficiently h.v. stress. The results may explain variations in sphere-gap measurements. A. M. T.

4143. Discharge Characteristics of a Siemens Ozone Tube. A. Klemenc, H. Hintenberger and H. Höfer. *Zeits. f. Elektrochem.* 43. *pp.* 708–712, *Aug.*, 1937.—The physical characteristics of the silent discharge in an ozone generating tube energised by a.c., are examined by means of a kathode-ray oscillograph. It is shown that the discharge current flows in periodic bursts, lasting about half the length of the corresponding half periods of the applied voltage cycle. It is suggested that these results account for the observations of Warburg on the apparent presence of a h.f. discharge in the ozone tube. The presence of true h.f. currents could not be confirmed. J. E. R.

4144. Ignition of the Positive Column and Townsend's Theory. G. Mierdel and M. Steenbeck. *Zeits. f. Physik,* 106. 5–6. *pp.* 311–314, 1937.—A condition is derived for ignition of the positive column of a gas discharge, which takes account of the ionisation by electron impact in the gas and the liberation of electrons at the kathode by positive ions, as well as the diffusion of the charge carriers to the tube walls. For large tube widths the condition becomes the same as Townsend's. In very long positive columns each electron must produce ionisation about once during its effective life, so that, in contrast to Townsend's case, ignition takes place with single electron canals. A. W.

4145. Diffusion Theory for Low-Pressure Hg-Vapour Positive Column. B. Klarfeld. *Phys. Zeits. d. Sowjetunion,* 11. 6. *pp.* 669–671, 1937. *In German.*—A criticism is made of the results obtained by Engel and Steenbeck [see Abstract 320 (1937)] in measurements of Hg vapour rectifiers and it is concluded that the discrepancies between Engel and Steenbeck's results and those of other workers are due to the experimental methods employed. A. W.

4146. Starting Voltages of the Low-Pressure Corona Discharge. L. B. Loeb. *J. of Applied Physics,* 8. *pp.* 495–496, *July,* 1937.—Townsend's criterion for sparking is applicable to the case of corona. In a sufficiently accurate form it reads $\alpha/\beta = e^{\int_a^r \alpha dx}$, where α is the number of electrons produced by collision per cm. advance in the field direction by an electron and β represents a similar quantity produced by positive ion impact in the gas. In the divergent field about a corona wire the exponent which in uniform fields is $\alpha\delta$ must be replaced by $\int_a^r \alpha dx$, where a is the radius of the wire and r is a radial distance from the axis where the field is no longer able to give α an appreciable value. Both α and the quantities which replace β are functions of the field strength X and the pressure p. Replacing β by appropriate expressions for the cases of positive and negative wires an explanation is given of the behaviour of the starting potential V_s in pure and in mixed gases. [See also Abstract 4314 (1936).] A. W.

4147. Anode Fall in He, Ne and A. M. J. Druyvesteyn. *Physica,* 4. *pp.* 669–682, *Aug.,* 1937. *In German.*—In a glow discharge as well as in a hot kathode arc the dependence of the potential across the tube of the distance between the electrodes is measured in He, Ne and A. At a definite distance (D) the potential increases rapidly, while an anode fall arises. The distances D in a glow discharge and in an arc discharge have about the same value. For high pressures the product of D and the gas pressure is shown to be independent of the pressure, whereas at low pressures this product decreases with decreasing pressure. This behaviour is explained by interpreting the Faraday dark space as a plasma. Measurements of the potential across the tube as a function of the pressure with a constant electrode distance agree with the results just mentioned. AUTHOR.

4148. Secondary Processes of Ionisation in Mercury Vapour. B. L. Snavely. *Phys. Rev.* 52. *pp.* 174–183, *Aug.* 1, 1937.—The ionisation occurring in mercury vapour as the result of the impact of electrons of energy less than 10·4 V is studied by use of a tube containing a small filament, the emission of which was limited by space-charge. The ionisation produced is studied as a function of electron velocity, bombarding current and pressure of the Hg vapour. For electron velocities above 7 V the data are in agreement with the assumption that the larger part of the ionisation is the result of ionisation of metastable atoms by electron impact. Critical potentials at 8·4 and 8·6 V are identified with the configurations $5d^9 6s^2 6p\ {}^3P_1{}^0$ and $5d^{10} 6s 7p\ {}^3P_1{}^0$, respectively. Another critical potential at 6·9 V is tentatively identified as the difference between the lower metastable level, $6s6p\ {}^3P_0{}^0$, and a negative energy level, $6p^2\ {}^3P_1$. Large numbers of negative ions are found in the neighbourhood of 4·9 V. It is suggested that ionisation observed in this region is due to the simultaneous formation of a positive ion and a negative ion upon the collision of a 2^3P_0 atom with a 2^3P_1 atom. AUTHOR.

4149. Magnetic Focusing of Ion Beams. H. A. Straus. *Phys. Rev.* 52. *pp.* 128–130, *July* 15, 1937.—In the mass spectrographs constructed hitherto, the ion beam enters the magnetic field at right angles. Herzog has shown in his treatment of ion optics that focusing can also be attained when the ion beam enters the field along a line other than the field normal. An experiment is described which affords a test of the predictions as to the effect of the angle of incidence on the position of the focus. Satisfactory agreement between the observations and the theory is found. AUTHOR.

4150. Spurious Lines Observed in the Mass Spectrometer without Magnetic Field. H. Hintenberger and J. Mattauch. *Zeits. f. Physik*, 106. 5–6. *pp.* 279–290, 1937.—A generalisation of Smythe's theory of the ionic velocity filter leads to a complete explanation of the appearance of spurious lines or " ghosts " in the mass spectrometer in which the velocity filter is followed by a cylindrical condenser. Simple formulæ for calculation of the positions of " ghost " lines are derived and it is indicated how disturbance of the mass line spectrum by " ghosts " may be avoided by suitable design of the spectrometer. J. E. K.

***4151. Universal Counter. A. Dauvillier.** *Comptes Rendus*, 205. *pp.* 36–37, *July* 5, 1937.—The arrangement described, analogous to that of Gisoff [see Abstract 1330 (1937)], is specially useful in connection with measurement of cosmic rays by means of sound-balloons. C. A. S.

***4152. Efficiency of Counters and Counter Circuits. A. E. Ruark and F. E. Brammer.** *Phys. Rev.* 52. *pp.* 322–324, *Aug.* 15, 1937.—Existing formulæ for correcting counter data for " missing " are found to apply to conditions which often cannot be realised in practice. Let τ_c, τ_i, and τ_r be the recovery times of the counter, amplifier and recording unit. It is shown that excellent performance can be obtained by using an amplifier which controls the voltage recovery of the counter so that $\tau_c = \tau_i =$ constant. When the counter receives f particles/sec., capable of activating it, the efficiency of the entire apparatus is $(1 + f\tau_i)^{-1}$ if $\tau_r < \tau_i$. It is $e^{-f(\tau_r - \tau_i)}/(1 + f\tau_i)$ if $\tau_r > \tau_i$ and the recorder is not influenced by any impulse which reaches it while it is operating. AUTHORS.

4153. Kathode Dispersion from Pure and Oxidised Mg Surfaces. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 106. 5–6. *pp.* 365–370, 1937.—Experiments are described in which the amount of dispersion of a discharge tube kathode under ionic bombardment is measured, using pure Mg and Mg coated with MgO as kathodes, the gases being H_2, He, A and O_2. It is shown that the dispersion from the coated kathode is only about 4% of that from the pure metal under comparable conditions. The dispersion is very small in H_2 and zero in He. In explanation of the low dispersion from MgO, it is suggested that the effect is due to the fact that the Mg in the compound is in the form of ions. These ions are removed by the bombardment, but are in general immediately attracted to the negative electrode again, only a few escaping by combination with free electrons. J. E. R.

4154. Kathode Dispersion from Cu in H_2 and D_2. A. Güntherschulze. *Zeits. f. Physik,* 106. 5–6. *pp.* 371–372, 1937.—Using a gas discharge from a Cu kathode at 2000 V and 20 mA it is shown that the dispersion of the Cu under the ionic bombardment is the same in H_2 and D_2. As considerable variations in the amount of dispersion are found in the other noble gases, it is suggested that these effects must be due to some cause other than the differences in ionic mass. J. E. R.

4155. Electrographic Effect. Elizabeth Schickele and P. H. Carr. *J. of Applied Physics,* 8. *pp.* 558–560, *Aug.,* 1937.—A portion of a metal surface was protected by means of a stencil during exposure in air to 100 kV kathode rays. An attempt was then made to " develop " an image of the stencil on the metal surface by the action of some chemical or other reagent. Results confirm previous reports that water vapour is helpful if not essential to satisfactory development. On the metals Ag, Cu, Sn, Zn, Pb, Bi and brass, the inorganic materials investigated for developing properties were superior to the organic materials tried. The image was not developed directly by electroplating by any method yet tried on any material except carbon. Attempts to produce an image in relief by first developing it in the ordinary way and then electroplating the specimen, failed except when anthraquinone was used as the developer. However, results by this method were uncertain. Cadmium vapour as a developer produces images of low relief. AUTHORS.

See also Abstract 4038.

CONDUCTION IN SOLIDS AND LIQUIDS.

4156. Electronic Theory of Metals. K. Ariyama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 714. *pp.* 103–119, *July,* 1937. *In German.*—The Schubin-Wonsowsky method [see Abstract 3611 (1935)] in which a polar model is used, is applied to explain the ferromagnetic properties of metals. The method is extended, eigenfunctions being calculated for linearly combined waves instead of for monochromatic waves. To do this simplifying assumptions are made which limit the temperatures to values well below the Curie temperature, and the number of polar atoms to a small fraction of the total number of atoms. The treatment shows the saturation magnetisation to be given by the Bloch $T^{3/2}$ law, with the addition, however, of a small correction term having the form $T^{3/2}e^{-\theta/2T}$. The ferromagnetism of polar atoms somewhat resembles the conductivity of a semiconductor. R. W. P.

4157. Theoretical Treatment of Foucault Currents. K. Bászel. *Zeits. f. Physik,* 106. 5–6. *pp.* 343–353, 1937.—The treatment deals with eddy currents in a large mass of ferromagnetic material at rest in an a.c. field. A simple expression is derived from the Maxwell equations for the eddy current density distribution; this is discussed with emphasis on the physical aspect. The complex permeability described by Arkadiew is considered by treating the phenomenon of hysteresis in an analytical manner. Certain expressions are derived which show that the amplitude of the eddy current does not fall off from the edge to the centre of the body as rapidly as it does for the " ideal " case in the Maxwell-Thomson theory, whilst the phase changes more rapidly. The local variation in permeability is next considered in an attempt to account for this variation. After discussing the relation $\mu = f(\mathrm{H})$, the eddy current density distribution comes out much more homogeneous whilst the phase is governed by a logarithmic rather than by a linear law. A new definition of coefficient of self inductance is suggested whereby the relation between reactance and field strength may be deduced, giving values which are in agreement with those of experiment. H. J. H. S.

4158. Heat Treatment and Electrical Conductivity of Thin Films of Potassium Chloride and Sulphur. H. Saegusa and T. Matsumoto. *Tohoku Univ., Sci. Reports*, 26. *pp.* 159–166, *June*, 1937. *In English.*—The electrical conductivity of evaporated films of KCl and S about 10^{-4} cm. in thickness is studied. It is found that the variation of the electrical conductivity with the temperature of a fresh film of KCl nearly satisfies the formula $\log \sigma = B + A/T$, and that after a heat-treatment the electrical conductivity satisfies extremely well the above equation, and that its magnitude decreases to about one-tenth or one-hundredth of that of the fresh film due to the recrystallisation. The magnitude of the change of the electrical conductivity due to the heat-treatment of the film, becomes larger as the temperature of the heat-treatment rises. In the case of a S film, the change of the electrical conductivity due to the heat-treatment is somewhat different, and is not so distinct as that of the KCl film. [See also Abstract 3217 (1937).] AUTHORS.

4159. Supraconducting State. F. B. Silsbee. *Washington Acad. Sci., J.* 27. *pp.* 225–244, *June* 15, 1937.—Summary of recent work on supraconductivity. R. P.

4160. Gradual Penetration of a Magnetic Field into a Supraconducting Tin Sphere. W. J. de Haas, (Miss) A. D. Engelkes and O. A. Guinau. *K. Onnes Lab. Leiden, Comm.* 247*e*. *Physica*, 4. *pp.* 595–600, *July*, 1937. *In English.*—The field surrounding a tin sphere is measured by means of small Bi wires fixed on the surface of the sphere and in channels inside it. If an external field is applied, the field as measured by the wires on the surface is such as would be expected if the lines of force would begin to penetrate into the interior as soon as the field on the surface reaches the critical value. The wires inside, however, are affected only for slightly larger values of the external field. Moreover, when they first show an effect this depends markedly on time, several minutes being required for the establishment of equilibrium. R. P.

4161. Resistance-Temperature Curve of Gold. W. J. de Haas and G. J. van den Berg. *K. Onnes Lab., Leiden, Comm. No.* 249*b*. *Physica*, 4. *pp.* 683–694, *Aug.*, 1937. *In English.*—In accordance with the earlier measurements [see Abstract 3307 (1936)] the resistance-temperature curves of the gold wires measured show a minimum. The influence of the annealing time remains confined to a shift of the minimum. A heating of the wire by the measuring current cannot be the cause of the minimum. AUTHORS.

4162. Effect of Betaine on the Conductivity of Sodium Hydroxide Solutions. R. F. Nielsen. *J. Phys. Chem.* 41. *pp.* 723–727, *May*, 1937.—The effect of small amounts of betaine on the equivalent conductivities of NaOH solutions of several concentrations, up to 1 *N*, is studied. The observed effect, at concentrations from 0·05 *N* to 1 *N*, is only about half that produced when the ionic strength is increased by the addition of an equimolal quantity of NaOH. AUTHOR.

4163. Conduction in Liquid Dielectrics. K. H. Reiss. *Ann. d. Physik*, 30. 1. *p.* 34, *Sept.*, 1937.—A correction. [See Abstract 1795 (1937).]

See also Abstracts 3869, 4104, 4107, 4177, 4194, 4223.

DIELECTRICS AND CAPACITANCE.

4164. Dipole-Dipole Coupling in Dielectric Media. J. H. van Vleck. *J. Chem. Phys.* 5. *pp.* 556–568, *July*, 1937.—The mathematical treatment of dipole-dipole coupling in magnetism [see Abstract 2707 (1937)] needs only minor modification for the electric case. Because of fluctuation effects, the use of the usual Lorentz local field and of the Clausius-Mossotti formula cannot be justified except as a first approximation valid at low density; consequently polar liquids need not exhibit the electric analogue of ferromagnetism, and hence the hypothesis of hindered rotation, as in the theories of Fowler and Debye, may not be necessary to explain the absence of spontaneous polarisation and the non-occurence of much saturation curvature in strong applied fields. Calculations on the translational fluctuation effect, causing deviations from the Clausius-Mossotti expression in gases, are extended to include polar molecules, and agree adequately with available experimental measurements on NH_3. N. M. B.

4165. Solvent Effect in Dielectric Polarisation. Parts I and II. G. Thomson. *Chem. Soc., J. pp.* 1051–1057, *July*, 1937.—References are given to previous work directed towards the formulation of an expression which would make possible the calculation of the molecular moment in the vapour state from measurements in one or more solvents. The present work has been undertaken to test the applicability of some of the equations proposed over a wider range of dielectric constant than is afforded by the non-polar solvents commonly used in such work. It was found that the polarisations of nitrobenzene and chlorobenzene in isopropyl, *n*-butyl, and amyl ethers were found to be consistent with the results obtained in other solvents, including chloroform. The linear relationships proposed by Jenkins, Frank, and Higasi were found to be invalid for polar solvents. The empirical relationship proposed by Müller was found to give a linear graph for polar and non-polar solvents, though extrapolation gives a value for the gaseous state which is too low. Measurements of the polarisations of butyl and amyl ethers in benzene and in hexane show a decrease in polarisation with decreasing dielectric constant of solvent as had been predicted for substances with negative values of Kerr constant. H. H. Ho.

4166. Deformability of Molecules in Electric Fields. A. Piekara. *Acta Physica Polonica*, 6. 2. *pp.* 150–157, 1937. *In German.*—A generalisation of the author's theory relating dielectric constant and changes in the electric fields. W. R. A.

4167. Dielectric Constant of Rochelle Salt. W. Bantle and G. Busch. *Helv. Phys. Acta*, 10. 4. *pp.* 262–264, 1937. *In German.*—The authors point out that the negative dielectric constant found by Zeleny and Valasek [see Abstract 4689 (1934)] for Rochelle salt at wavelengths less than 20 m. is likely to be due to neglect of inductance in the leads to the specimen. Measurements made in such a way as to make this inductance negligible give a value for the dielectric constant of 100 at all wave-lengths between 300 m. and 40 cm. W. H. W.

4168. Dielectric Properties of Water-Dielectric Interphases. H. Fricke and H. J. Curtis. *J. Phys. Chem.* **41.** *pp.* **729–745,** *May,* **1937.**—The dielectric properties of water-dielectric interphases are studied by measuring the dielectric constant and conductance of suspensions, and the dependence of these quantities upon frequency, volume concentration of suspension, size of suspended particles, and the characteristics of interphase and suspending fluid. Measurements are made at frequencies from 250 to 2×10^6 ~ by a substitution method in which the suspension is compared with a potassium chloride solution. Errors due to electrode polarisation are eliminated by varying the electrode distances of the measuring cells. A theory for the calculation of the interphasial capacitance and conductivity of a suspension of spherical particles is given, and relations between these properties and frequency are derived which are in agreement with experiment. Data for a number of colloidal solutions are given. The high dielectric constants often reported for colloidal solutions are considered to be due to the interphasial capacitance. E. R.

4169. Dielectric Properties of Acetylenic Compounds. Part VIII. S. M. Koehl and H. H. Wenzke. *Am. Chem. Soc., J.* **59.** *pp.* **1418–1420,** *Aug.,* **1937.**—Electric moments have been determined for several acid chlorides: acetyl, propionyl, butyryl, benzoyl, cinnamoyl, butylpropiolyl and amylpropiolyl. The data from dipole moments alone do not establish definitely the existence of resonance in the alkyl acid chlorides. The consideration of the data of dipole moments and chemical reactivity indicates quite strongly the existence of resonance in these compounds. Three forms have been assumed to contribute to the molecule. The moments of the acid chlorides attached to unsaturated hydrocarbon residues are higher than those of the alkyl acid chlorides. Resonance of the acid chloride group with the unsaturated hydrocarbon residue readily accounts for this increase in moment. [See Abstract **3233** (1937).]
AUTHORS.

4170. Action of Electric Field on Insulator in Air. F. Perrier. *Comptes Rendus,* **205.** *pp.* **33–36,** *July* **5, 1937.**—The current, measured by an electrometer, between two conducting plates (I and II) separated by one of amber and an air space, was measured with (1) the amber not electrified and a p.d. of 640 V between I and II, (2) the amber electrified and both I and II earthed, and (3) the amber electrified and p.d. 640 V between I and II. The result with (3) differs greatly from the total of those with (1) and (2), and hence the air space above the amber obviously plays an important part. That this is due to ionisation of the air is confirmed by the fact that if the pressure of the air therein is reduced to 1 mm. of Hg the amber loses its electrification very much more rapidly than at ordinary pressure. [See Abstract **4443** (1936).] C. A. S.

4171. New Type of Permanent Polarisation of Dielectrics. G. Nadjakoff. *Comptes Rendus,* **204.** *pp.* **1865–1866,** *June* **21, 1937.**—If sulphur, under the action of an electric field, is kept in the dark a few moments before the removal of the field, the resulting polarisation persists for long periods, and is termed permanent photo-polarisation in contrast to the thermo-polarisation reported by Eguchi [see Abstract **1165** (1925)]. **Errata,** *ibid.* **205.** *p.* **343,** *Aug.* **2, 1937.** N. M. B.

4172. Dielectric Loss and Polarisation in Glasses. J. Skanavi. *Techn. Phys., U.S.S.R.* **4. 4.** *pp.* **289–307, 1937.** *In English.*—Experimental data relating to losses and dielectric polarisation in glasses are presented and the causes discussed. To study the relation between the dielectric properties and concentration of metal ions, boron glasses containing Na_2O, BaO and PbO were prepared. Tan δ and ϵ at 2000 kc./sec. and at 50∼ were determined from −180° C. to the melting-point of the glass. The results suggest that the dielectric loss at high frequencies is the resultant of three components, structural, relaxational, and conduction, with the relaxational component predominating in most cases. Addition of metal ions increases the conduction component and also, sometimes, the structural, but decreases the relaxational loss. The polarisation is chiefly ionic in character. The relaxation and polarisation introduced by the addition of metal ions may be explained as an effect of the motion of the ions in restricted pores inside the glass. The losses are reduced by crystallisation when the added constituent, which causes increased relaxation loss, crystallises. The monovalent ions of the alkali metals have greater influence than the divalent metals on the losses and polarisation in glass. A. M. T.

See also Abstracts 3815, 3818, 3852, 3853, 4082, 4112, 4134.

ELECTROCHEMISTRY.

40
37

4173. Temperature and Hysteresis Errors in Calomel Half-Cells. B. Wingfield and S. F. Acree. *Bureau of Standards, J. of Research,* 19. *pp.* 163–175, *Aug.,* 1937.—Saturated and undersaturated KCl-calomel half-cells were subjected to temperature changes between 22·5 and 31·3° C. and the difference in e.m.f. between them and saturated calomel half-cells at 25° C. was measured. During an 8° C. change, maximum differences of 0·5 to 0·9 mV were found between the measured e.m.f. values and the equilibrium e.m.f. values corresponding to the temperature of the KCl solutions. Potentials within 0·2 to 0·3 mV of the equilibrium value were obtained in 2 to 3 hrs. after an 8° C. change. Calomel half-cells protected with dewar flasks against small fluctuations in room-temperature were more stable in potential than the unprotected cells. The saturated half-cell had a $\Delta E/\Delta T$ of 0·25 mV/°C. and the undersaturated half-cell, 3·8 *N*, gave the value 0·47 mV/°C. One half-cell, saturated at 25° C. without an excess of KCl crystals, was measured and its $\Delta E/\Delta T$ was found to be erratic. AUTHORS.

4174. Second Dissociation Constant of Carbonic Acid. Y. Kauko and A. Airola. *Zeits. f. phys. Chem.* 179. *Abt.A.* 4. *pp.* 307–313, 1937.—The authors calculate the second thermodynamic dissociation constant of carbonic acid from the pH values of dilute soda solution. The acid degree of this solution was determined by potentiometric measurements in which dilute bicarbonate solution was employed as a comparison solution. Corrections were made for the diffusion potential, and the results were experimentally tested. The values obtained, $R_2 \times 10^{11}$, were :— 0° C., 3·19; 25° C., 5·73; 38° C., 7·35. The heat of dissociation calculated from these values is 3820 cal. between 0° and 25° C., and 3550 cal. between 25° and 38° C. F. J. B.

4175. Electrodeposition of Gallium. F. Sebba and W. Pugh. *Chem. Soc., J. pp.* 1373–1376, *Aug.,* 1937.—Though much work has been published on the electrodeposition of Ga, this has necessarily been accomplished with small amounts of the metal. The problem of dealing with larger amounts, such as are available from germanite, is quite different. Moreover, in spite of the work already published, there is little in the literature to indicate what degree of success may be expected under various conditions. For this reason, the conditions for the successful electrodeposition of quantities of the order of 10 gm. of metal have been studied. The metal obtained in this way from germanite contains traces of Pb, Sn and Pt, and it is shown that the last traces of these impurities are removed by simple washing with HCl and HNO_3. The behaviour of the metal towards acids has also been studied. AUTHORS.

4176. Theory of Electrolysis in Solid Metals. K. Schwarz. *Zeits. f. Elektrochem.* 43. *pp.* 585–587, *Aug.*, 1937.—The passage of d.c. through molten metallic alloys results in the movement of the constituents in a manner comparable with electrolysis. It is shown qualitatively that the ion with the greatest charge density migrates to the kathode. The magnitude of the transport number in solid alloys depends, as in the molten alloys, upon their mobility and upon the diffusion constant, but is smaller in the case of solid alloys than for molten alloys. The results obtained for the little investigated cases of Cu-Au, Pd-Au and Fe-C showed a good agreement between the determined and calculated values for the direction of motion. In the system Pb-Au the unexpected result that gold migrated to the anode was obtained, hence Au must be assumed to be uncharged.
F. J. B.

4177. Van der Waals Forces in Solutions of Electrolytes. J. Lange and E. Herre. *Zeits. f. Elektrochem.* 43. *pp.* 592–595; *Disc.*, 595–596, *Aug.*, 1937.—The osmotic and conductivity coefficients, f_0 and f_μ, have been derived from accurate measurements of the freezing points and conductivities of strong electrolytes (KIO_3, HIO_3, $KClO_3$, picric acid, sodium picrate and sodium-α-dinitro-phenolate) in aqueous solution ($0\cdot005<c<0\cdot1$) and are expressed in power series of $\sqrt{c}$, viz.: $1-f_0 = A_0\sqrt{c} + B_0C + \ldots$, and $1-f_\mu = A_\mu\ (\Lambda_0)\ \sqrt{c} + B_\mu C + \ldots$, where A_0 (A_μ) denotes the known coefficients of the Debye-Hückel and Debye-Onsager limiting laws for strong electrolytes. It is found that $B_0 = B_\mu = -0\cdot6 \pm 0\cdot2$ for the alkali halides, *i.e.*, salts where no association phenomena occur. Ionic association always causes an increase ΔB_0 ($B_0 = -0\cdot6 + \Delta B_0$) whether the ions have like or unlike charges, whereas the corresponding change ΔB_μ is very sensitive with respect to these alternatives. From these data the association of the like and unlike charged ions has been deduced, and the former found to predominate. The attraction forces between ions with like charges cannot be of an electrostatic character but must be ascribed to quantum mechanical (van der Waals) forces. It follows from the present data that the individual behaviour of strong electrolytes must be ascribed mainly to quantum-mechanical (van der Waals) forces. H. H. Ho.

4178. Potential and Transport Number Measurements in Ferric Oxide Hydrosols. A. Lottermoser and H. Fritzsche. *Kolloid Zeits.* 80. *pp.* 44–56, *July*, 1937.—The determination of the activity of Cl-ions in an oxyhydrosol by aid of the calomel or silver electrode is found to be difficult since, in the absence of a standard for dilute sols, a higher activity is found than is warranted by the total Cl present. It is found that when the calomel electrode is prepared by saturating the calomel with the oxide under investigation, the difficulty is overcome. Similarly, correct values for the Cl-ion activity were obtained when the smooth Ag or AgCl electrode is immersed in the sol and ignited. If this is not done the potential decreases rapidly. An explanation of the observed facts is attempted.
F. J. B.

4179. Potential of the Ag(s), AgI(s), I^- Electrode. Jessie Y. Cann and Alice C. Taylor. *Am. Chem. Soc., J.* 59. *pp.* 1484–1486, *Aug.*, 1937.—The cell Ag(s), AgCl(s), *m* KCl(aq.), *m* KI(aq.) AgI(s), Ag(s) is investigated. The normal electrode potential of Ag(s), AgI(s), I^- is found to be $E^0 = +0{\cdot}1510$ and $\Delta F^\circ = -3485$ cal. AUTHORS.

4180. Normal Volta Potentials of Two-Phase Systems. O. Klein and E. Lange. *Zeits. f. Elektrochem.* 43. *pp.* 570–584, *Aug.*, 1937.—The absolute normal Volta potential for the most important electrochemical two-phase systems metal/metal salt solution (activity = 1) is developed and tabulated as well as expressed in the form of a figure. The error is of the order of 0·1 V as an average. By means of these values the changes of the Volta potentials for galvanic cells can be obtained, as illustrated by a graphic example. The significance of the Volta potentials so obtained for the calculation of the absolute true heat of hydration is shown. F. J. B.

See also Abstracts 3842, 3869, 3923, 4155.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

4181. Photographic Demonstration of Electron-Pair Generation. T. Takéuchi and T. Sugita. *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 555–556, *June*, 1937. *In English.*—The energy spectrum of positrons and electrons produced by the interaction of γ-rays (from Ra, filtered through 6 mm. of Pb) with Pb, Ag, Bi and Sn is examined photographically. The positrons show 5 distinct bands corresponding to the energy limits of positrons liberated by the γ-rays of energies 1·1, 1·2, 1·4, 1·8 and 2·2 eMV. F. C. C.

4182. Elementary Charge by the Oil Drop Method. Y. Ishida, I. Fukushima and T. Suetsugu. *Inst. Phys and Chem. Research, Tokyo, Sci. Papers, No.* 709. *pp.* 57–77, *June*, 1937. *In English.*—In view of discordant available values of *e*, a detailed investigation was undertaken, using an improved Millikan's apparatus and method, with special reference to possible errors arising from the effect of the convection current on the speed of the oil drop, evaporation and oxidation (or adsorption) of the drop, the shape of the drop, and the effect of the arc on the drop. Full data, with graphs, for nine typical drops are given. It is considered that the main difficulties of the method, formerly, have been the use of the predetermined density as the density of the drop under observation and the use of non-spherical drops, which are not permissible under Stokes's law, in conjunction with spherical drops. The determination gave $e = (4{\cdot}806 \pm 0{\cdot}003) \times 10^{-10}$ e.s.u. N. M. B.

4183. Existence of Heavy Electrons. E. C. G. Stueckelberg. *Phys. Rev.* 52. *pp.* 41–42, *July* 1, 1937.—A mathematical examination of the field theory leading to a prediction of the existence of charged particles of mass up to about 50 times the electron mass. [See also Abstract 1837 (1935).] N. M. B.

4184. Scattering of Fast Electrons in Hydrogen. A. L. Hughes and S. S. West. *Phys. Rev.* 52. *pp.* 43–45, *July* 15, 1937.—Electrons of 2000-V energy scattered by H_2 molecules are found to be divided into two distinct groups, those scattered elastically and those scattered inelastically. The former have been scattered by the nuclei, while the latter have been scattered by the atomic electrons. The theoretical ratio of the number inelastically scattered to the number elastically scattered differs according to whether one adopts the classical theory of scattering or the wave mechanical. The difference comes in through the fact that when particles are scattered by similar particles, such as electrons by electrons, the two theories lead to different expressions. The experimental results are in much closer agreement with the predictions of the wave mechanical theory than with those of the classical theory. A slight difference between the results obtained with He and those obtained with H_2 may be attributed to diffraction effects which are present when scattering is due to diatomic molecules. AUTHORS.

4185. Effects of Long Range Forces on Neutron-Proton Scattering. S. S. Share and J. R. Stehn. *Phys. Rev.* 52. *pp.* 48–51, *July* 15, 1937.—Experiments on the angular distribution of fast neutrons scattered by protons have yielded conflicting results. Some indicate spherically symmetric scattering in the centre-of-gravity coordinate system; this is consistent with the ordinarily assumed short range interaction (radius $< 3 \times 10^{-13}$ cm.). Others indicate a greater amount of scattering in the backward direction. It is here shown that this asymmetry could be explained by assuming an additional long range interaction which is *attractive* for *p* particles. If of the Majorana type, this interaction is consequently repulsive for *s* particles. Such an interaction, of depth 1 mc^2, extending out to a radius of 11×10^{-13} cm., is roughly sufficient for the purpose. AUTHORS.

4186. Electron Scattering in Helium. M. Goodrich. *Phys. Rev.* 52. *pp.* 259–266, *Aug.* 15, 1937.—An electron scattering apparatus is used to investigate the scattering of 100 V incident electrons in He. The angular distribution curves for total scattering and for elastic scattering are compared with the theory as given by Morse and by Mott and Massey and are found to give greater relative scattering at angles near both 0° and 180° than is predicted by the theory. In absolute magnitude the experimental curves generally fall somewhat below the theoretical curves. The angular distributions of electrons scattered with various energy losses equal to or greater than the ionisation loss are determined. The curves show that in general, the greater the energy loss the more uniform is the distribution in angle of the scattered electrons. There is a pronounced preference for forward scattering when the energy loss over that required for ionisation is small. Integration over the entire solid angle gives the probability for scattering with different energy losses. Curves so obtained for this probability as a function of the energy loss are in qualitative agreement with Wetzel's theoretical calculations except for electrons which have lost nearly all their energy or just slightly more than the ionisation energy. AUTHOR.

4187. Absorption of High Energy Electrons. Part I. J. J. Turin and H. R. Crane. *Phys. Rev.* 52. *pp.* 63–67, *July* 15, 1937.—The recoil electrons produced by the 6 eMV γ-radiation from F bombarded with protons were allowed to pass through 5 mm. C and 0·5 mm. Pb absorbers placed across the centre of a cloud chamber. The curvatures of the incident and emergent tracks in the magnetic field were measured, the difference giving the loss in passing through the absorber. The losses in C are in good agreement with the theoretical losses due to electron collisions alone, and this is satisfactory, since practically no radiative losses are expected in a substance of such low atomic number. In the case of Pb, the data show clearly that radiative losses play a large part, and increase with increasing energy of incident particle. The losses in Pb are slightly greater than those predicted by theory. AUTHORS.

4188. Range of Protons in Aluminium and in Air. D. B. Parkinson, R. G. Herb, J. C. Bellamy and C. M. Hudson. *Phys. Rev.* 52. *pp.* 75–79, *July* 15, 1937.—By the use of a two-million volt generator the range of protons in air and in Al has been measured as a function of proton energy up to about 2 eMV energy. The range in air data are in good agreement with the theoretical values of Mano at high energies but diverge considerably at energies below 0·7 eMV. The ratio of the range in air to the range in Al has been found to increase from a value of approximately 1000 at 200 kV to a value of 1550 at 1200 kV. From 1200 kV up to the maximum voltage available the ratio is shown to remain nearly constant. AUTHORS.

4189. Demonstration of Imagery Defects of Electron Lenses. E. Gundert. *Phys. Zeits.* 38. *pp.* 462–467, *June* 15, 1937.—The introduction of a small amount of gas into an electron optical system renders the beam visible, and use is made of this to examine the aberrations of electric and magnetic lenses. The paths of a number of narrow beams which traverse the lens at different distances from the axis are observed, and diagrams are given to illustrate these paths in certain simple symmetrical arrangements. In the electric lenses described, space-charges cause a deviation of the beam path from that observed in a high vacuum, but this deviation is small at voltages of a few hundred volts. The aberrations of all the lenses examined are positive, and a brief description is given of a method of reducing the aberration by a suitable arrangement of the field of the lens. H. J. H. S.

4190. Effect of Space-Charge in Electron Optics. M. Cotte. *Comptes Rendus*, 204. *pp.* 1933–1935, *June* 28, 1937.—An axially symmetrical electron optical system is considered in which electrons of comparatively slow velocities are emitted by a small plane surface at right angles to the electron axis. A number of simple assumptions are made from which expressions are derived enabling the electron trajectories to be deduced. Certain terms in the expressions depend on space charge and a method of successive approximation is suggested for calculating these terms. H. J. H. S.

4191. Gauss Approximation for General Electron-Optical System. M. Cotte. *Comptes Rendus*, 205. *pp.* 129–131, *July* 12, 1937.—The trajectories of particles in stationary electromagnetic fields are deduced: two differential equations in x and y are derived, in which the coefficients are functions solely of the independent variable z. A simple approximation method of solving these equations is given and certain simple cases are treated theoretically. H. J. H. S.

4192. Focusing of Corpuscular Beams by Deviation in a Transverse Magnetic Field. L. Cartan. *Comptes Rendus*, 205. *pp.* 126–129, *July* 12, 1937.—The position of the image of an object emitting a divergent beam of electrons for the general case of any magnetic field has been worked out by R. Herzog; the author verifies the results by simple geometrical considerations. For certain cases an expression is derived from which the optical constants of the system may be deduced; it is of value in a number of experimental arrangements, 3 of which are given in illustration. H. J. H. S.

See also Abstracts 3804, 3813, 3814, 3841, 3906, 3914, 4026, 4027, 4224.

ELECTROSTATICS.

4193. Cause of Fire in Dirigibles. A. Milhoud. *Comptes Rendus*, 205. *pp.* 113–115, *July* 12, 1937.—It is known that airships catch fire both in the air and on landing. The dirigible, as it passes through an electrically charged atmosphere, becomes electrified by induction and the potential is greatest at the pointed rear of the ship, where, on sinking to the earth the excess of gas is allowed to escape. As gas flows through a narrow opening a spark may be formed under the two following conditions (1) when the gas contains droplets of water and (2) when the surface tension of the drops changes quickly as the gas leaves the valve. The hydrogen used always contains some water, and although the difference in pressure inside and outside the balloon is small, the surface may be so highly electrified, that a rapid change in surface tension occurs and the potential between the drops and the surroundings quickly attains a value great enough to give a spark. Experiments can be made to see if this is the cause of the loss of dirigibles and to prevent similar catastrophes where hydrogen is used to fill the balloons. H. M. B.

***4194. Absolute Standard for Measurement of Very High Voltages: Electrostatic Valve. M. Pauthenier, M. Feldenkrais and L. Vigneron.** *Comptes Rendus*, 205. *pp.* 117–119, *July* 12, 1937.—Using the h.v. generator [see Abstract 3255 (1937)] in the open air, voltages up to 400 ekV are compared on a rotating voltmeter of Kirkpatrick type and the new instrument which is based on the principle of automatic self-lifting of a pellet from an electrically charged surface. The latter arrangement, which constitutes a sort of electrostatic valve, is especially convenient for use by an observer in an insulated conducting sphere, when the p.d. between sphere and ground is required. F. C. C.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4195. Gerlach's Thermomagnetic E.M.F. in Ni, Fe, and Ni-Fe Alloys. N. Yamanaka. *Tohoku Univ. Sci. Reports*, 26. *pp.* 40–54, *June*, 1937. *In English. Reports Nos.* 418 *and* 419 *of the Research Inst. for Iron, Steel and other Metals.*—In the first Report, Gerlach's thermomagnetic e.m.f. [see Abstract 5291 (1936)] in Ni-Fe alloys of various compositions is observed, and the dependences of it on the applied magnetic field, the temperature gradient, the composition and also on thermal treatments of the test wires are fully studied. In the second Report the effects of tension and torsion are studied. The main results obtained are: (1) in Ni and Ni-Fe alloy (87·5 % Ni) the saturation value of the e.m.f. and the intensity of magnetic field at which the e.m.f. is saturated, increase with increase of tension, (2) in Ni-Fe alloys which contain Ni less than 87·5 % the greater the tension applied the smaller the e.m.f. generated, (3) in Fe, the application of tension results on the one hand in diminution of the positive maximum value of the e.m.f., and on the other hand in displacement of the field intensity, at which the e.m.f. changes its sign, toward the weaker field, (4) the torsion results in the decrease of the e.m.f. in Fe and Ni. AUTHOR.

See also Abstract 4200.

MAGNETISM AND ELECTROMAGNETISM.

4196. Theory of Ferromagnetism. Lowest Energy Levels. J. C. Slater. *Phys. Rev.* 52. *pp.* 198–214, *Aug.* 1, 1937.—The connection between the theory of ferromagnetism formulated by the method of energy bands and by the method of spin waves is investigated and a problem is considered in which N-1 electrons in a band have one spin and one electron the opposite spin. Orthogonal atomic functions are used for these have certain advantages over the non-orthogonal functions usually employed. A set of unperturbed wave functions, each of which can be expressed in terms of the other, is given by the 2 methods, although neither expresses the true situation. It appears that, below the continuum of levels indicated by the energy band theory, there is a set of discrete levels, the lowest of these being a spin wave and being the state normally occupied. The discrete levels approach the continuum in the limit of broad energy bands and for non-ferromagnetics; their wave functions represent a situation in which the electron can migrate to a great distance (not infinity) from the positive ion which it has left. The spin wave theory is to be used for studying the temperature variation of magnetisation whilst the energy band theory leads to approximately correct conclusions as to which elements are ferromagnetic. H. J. H. S.

4197. Domain Theory of Ferromagnetics under Stress. Part I. W. F. Brown, Jr. *Phys. Rev.* 52. *pp.* 325–334, *Aug.* 15, 1937.—The statistical domain theory of ferromagnetism, introduced by Heisenberg and extended by others, is developed in a general form capable of application to any ferromagnetic, crystalline or polycrystalline. Formulæ are derived by which the magnetisation and strain components can be computed to the first order in the stresses, provided the magnetisation curve at zero stress is known. The analysis is valid at any magnetisation below that at which the rotation process begins, and the six stress components may have arbitrary values. The formulæ are then specialised to nickel crystals; the results reduce to those of Gans and v. Harlem, and of Akulov and Kondorsky, for the special cases treated by them, except for one formula of the former authors and one of the latter. In these cases the original formula is shown to be in error, and the corrected formula leads to better agreement with experiment. AUTHOR.

4198. Coercive Force and Irreversible Changes in Magnetisation. E. Kondorski. *Phys. Zeits. d. Sowjetunion,* 11. 6. *pp.* 597–620, 1937. *In English.*—After a discussion of the irreversible changes of magnetisation which are a result of the displacement of the boundaries between regions of spontaneous magnetisation, it is assumed (differing from Bloch's theory) that the position and equilibrium of the boundaries are determined by the minimum magnetic energy and the elastic energy (which exists owing to magnetostriction of the boundary layer and varies with its displacement). The theory of irreversible changes of magnetisation is then built up and the coercive force of the region is computed as a function of the width of the boundaries, the internal stress gradients and the field orientation of the spins. An explanation is offered of the decrease of coercive force on elongation in materials with positive magnetostriction. Formulæ are given for remanence and coercive force curves and their relation with hysteresis loop is discussed. The remanence-intensity and coercive force-intensity curves for different tensions are calculated and compared with experimental values; good agreement is found.

H. J. H. S.

4199. Coercive Force in Single Crystals. K. J. Sixtus. *Phys. Rev.* 52. *pp.* 347–352, *Aug.* 15, 1937.—The coercive force H_e of ten single crystal discs of silicon-iron has been measured in different directions in their planes. In any one disc, H_e changes with the direction; it is mainly determined by the angle α_3 between the field and the [001] axis nearly normal to the disc, and has a minimum value when that angle is 90°. The angle α_1 between the field direction and another cubic axis which lies nearly in the plane of the disc and close to the field direction has a smaller effect on H_c. The relation $H_c = A/\cos\alpha_1 + B\cos\alpha_3$ represents very closely the curves taken on well annealed discs; A and B are constants with values close to 0·1 and 0·4, respectively. The effect on H_c of varying the disc shape and of increasing the internal strains by carburisation has been studied. Finally it has been shown that H_c values calculated from the empirical relation are in good agreement with data on single crystal wires and strips (Kaya, Ruder).

4200. Effect of Temperature on the Discontinuous Process of Magnetisation in Ni and Ni-Fe Alloy. M. Takagi. *Tohoku Univ., Sci. Reports,* 26. *pp.* 55–64, *June,* 1937. *In English. Report No.* 420 *of the Research Inst. for Iron, Steel and other Metals.*—In the present experiment, the effect of temperature on the discontinuous process of magnetisation in Ni and Ni-Fe alloy (40 % Ni) is observed. The main results obtained are summarised as follows :—(1) the discontinuous process of magnetisation diminishes on the whole almost linearly with the rise of temperature ; (2) the prominent discontinuous jumps in strained materials displace generally toward weaker fields, but sometimes toward stronger fields. [See Abstract 1373 (1937).] AUTHOR.

4201. After-Effect Loss in Nickel-Iron Alloys. E. Seyffert. *Zeits. f. techn. Physik,* 18. 7. *pp.* 200–203, 1937.—A.c. measurements on a series of Ni-Fe alloys confirm that the after-effect loss passes through a pronounced maximum in the alloy containing 30 % Ni, as observed by Goldschmidt [see Abstract 775 (1933)]. The large after-effect loss, which is not associated with any exceptional lag of induction in ballistic measurements, is reduced to the normal value after prolonged annealing. With varying temperature the after-effect rises to a maximum a little below the Curie point. These results are explicable by Goldschmidt's theory that the after-effect loss results from inhomogeneity of the material owing to additional eddy-currents occurring at the boundaries between regions having different properties. The large effect in the 30 % Ni alloy is attributable to its low Curie point, which causes small variations in composition to produce large differences in magnetic properties. C. E. W.

4202. Recoil Cycles of Magnet Steels. H. Lacoste-Tayan. *Comptes Rendus,* 205. *pp.* 122–124, *July* 12, 1937.—Additional results are given in order to complete a previous paper [see Abstract 3746 (1937)]. A short summary is given of the recoil factors of different magnet steels as a function of the residual magnetisation and certain deductions are made concerning magnetic recoil in general (independent of the particular type of steel). H. J. H. S.

4203. Magnetic Interaction and Resultant Anisotropy in Unstrained Ferromagnetic Crystals. L. W. McKeehan. *Phys. Rev.* 52. *pp.* 18–30, *July* 1, 1937.—The mutual potential energy of two equal and parallel magnets is derived for several symmetrical distributions of magnetic moment. If R is the distance between magnet centres, the first three terms, in order of importance, depend on R^{-3}, R^{-5} and R^{-7}. These are called dipole, quadrupole and sextupole terms. Magnets previously considered as representing the atoms in a ferromagnetic crystal are special cases of one of the general cases treated in the paper. Sextupole terms have not been hitherto included. The distributions of magnetic moment dealt with permit a closer correspondence between the model magnet in Fe, Co and Ni and the probable distribution, in these atoms, of the electrons responsible for ferromagnetism. The method of computing ferromagnetic anisotropy in crystals is indicated and a comparison is made between theory and experiment. **Errata,** *ibid. p.* 527, *Sept.* 1, 1937. G. E. A.

4204. Ferromagnetic Materials at Low Temperatures. W. Opechowski. *Physica,* 4. *pp.* 715–722, *Aug.,* 1937. *In German.*—A mathematical derivation, on the basis of Heisenberg's theory of ferromagnetism, of the variation with temperature of the saturation magnetisation of a ferromagnetic material at low temperatures. In addition to the $(T/\Theta)^{3/2}$ term deduced independently by Bloch [see Abstract 2925 (1930)] and Kramers [see Abstract 2254 (1937)], a term proportional to $(T/\Theta)^2$ is obtained. C. E. W.

4205. Quantum Theory of the Diamagnetism of Aromatic Compounds. F. London. *Comptes Rendus,* 205. *pp.* 28–30, *July* 5, 1937.—A theory to explain the large diamagnetic anisotropy of aromatic compounds is developed. W. R. A.

4206. Coexistence of Dia- and Paramagnetism in Single Crystals of Sb-Sn Alloys. H. M. Hart. *Phys. Rev.* 52. *pp.* 130–131, *July* 15, 1937.—The effect of small additions of Sn to Sb is studied by measuring the magnetic anisotropy at room-temperature. Single crystals (free from Fe) are made from the melts and the measurements made by the Gouy method using a Sartorius microbalance and a Weiss electromagnet. The anisotropy ratio (ratio of magnetic mass susceptibility parallel to the principal crystal axis to that perpendicular to the same axis) for pure Sb is 2·52. A curve for the anisotropy ratio against % Sn shows a reversal in sign of the anisotropy ratio at about 1·25 % Sn ; the crystals thus become paramagnetic parallel to the trigonal axis. The results are compared with those of Bi-Sn alloys, in which a similar reversal is observed ; an explanation is offered by extending the argument of Mott and Jones. H. J. H. S.

4207. Paramagnetism of Complex Chromium Salts. L. Leiterer. *Zeits. f. phys. Chem.* 36. *Abt.B.* 5–6. *pp.* 325–338, 1937.—Susceptibilities of six complex chromium salts are recorded and compared with existing data. Measurements are given for room temperature and the temperature of boiling oxygen. Deviations from the Curie Law are small ($\theta \leqq 7°$). A relation between the θ values and the absorption spectra is established. W. R. A.

4208. Magnetic Inhibition of Susceptibilities at Radio Frequencies. C. J. Gorter and F. Brons. *Physica,* 4. *pp.* 579–584, *July,* 1937. *In English.*—A study of paramagnetic susceptibilities in h.f. alternating fields. In iron and chrome alums the susceptibility diminishes when a constant magnetic field is applied in the same direction as the alternating field. At the temperature of liquid nitrogen there is a saturation effect in very strong fields ; the effect disappears with rise of temperature. In vanadium alum at the temperature of liquid oxygen the constant field has no effect. An explanation of the effect is discussed. [See also Abstract 380 (1937).] G. E. A.

4209. Hysteresis of Magnetostriction of Fe, Ni, Co and their Binary Alloys. Y. Masiyama. *Tohoku Univ., Sci. Reports,* 26. *pp.* 1–39 *and* 65–85, *June,* 1937. *In English. Reports Nos.* 417 *and* 421 *of the Research Inst. for Iron, Steel and other Metals.*—In the first report the hysteresis of the magnetostriction caused by cyclic change of magnetic field in the cases of Fe, Ni, Co and single crystals of Fe is determined by varying the field gradually or suddenly. An anomalous phenomenon due to sudden change of field is observed ; *i.e.*, by suddenly annihilating the field, the residual elongation is considerably greater than that in the case of slowly reducing the field to zero. In the case of single crystals, a small hysteresis is observed, and the anomaly due to the sudden change of field is also found. This anomaly can be explained by the idea of inertia of angular motion of the elementary magnets or complexes ; *i.e.*, by sudden annihilation of field, the elementary complexes do not only turn over to their initial directions, but some of them further turn over to the next stable directions by inertia, and thus results the anomalous residual elongation. Starting from this anomalous state, if the field is applied, in the same or opposite direction, the elongation in the weak fields takes place in a direction such that the elongation is at first diminished and then increased. This is also similarly explained. In the second Report the hysteresis of magnetostriction and magnetisation for binary alloys of the systems Fe-Ni, Ni-Co and Fe-Co are measured ; the hysteresis phenomenon is generally conspicuous in a wide range of fields. AUTHOR.

*4210. **Measurement of Magnetic Fields. A. Kohaut.** *Zeits. f. techn. Physik,* 18. 7. *pp.* 198–199, 1937.—Describes a rotating search-coil apparatus for the rapid measurement of field-strengths down to 0·1 oersted. By measuring the e.m.f. induced when the coil is rotated by a synchronous motor running on frequency-controlled supply mains, high relative accuracy (0·1%) is obtainable, and an absolute accuracy better than 1% is claimed. The apparatus is not suitable for measurements of the field strength in a narrow gap. C. E. W.

See also Abstracts 3881, 3917, 4002, 4156, 4164.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4211. **Absolute Cardiogram. H. E. Hollmann and W. Hollmann.** *Zeits. f. Instrumentenk.* 57. *pp.* 285–297, *July,* 1937.—The application of vectorial representation to bio-electrical potentials in the so-called " Triogrammen " can be made to yield absolute measures of the heart potentials. This paper is concerned with the mathematical details of the working up of the results. G. E. B.

4212. **Electrotechnics in the Analysis and Interpretation of the Functioning of the Nervous System. A. Monnier.** *Soc. Franç. Élect., Bull.* 7. *pp.* 681–702, *July,* 1937.—The author points out how on the one hand the development of methods of analysis used in electrotechnics (amplifiers, oscillographs, etc.) have enabled the nature of nerve actions to be studied, and on the other hand scientific methods of calculation applied to certain problems (resonance, coupled circuits, etc.) have been transferred directly to the problem of the transmission of such actions between separate nerve cells. G. E. B.

4213. **Electric Knife in Surgery. E. H. Turle.** *El. Rev.* 121. *pp.* 81–82, *July* 16, 1937.—A note explaining the broad principles of the circuits used in surgical diathermy. G. E. B.

4214. **X-Ray Kymography of the Heart. J. Lorens.** *J. de Radiologie et d'Électrologie,* 21. *pp.* 294–297, *July,* 1937.—Reference is made to previous work in respect to cardiac kymography, particularly the grid method of Stumpf. To overcome the defects of this method, the author has constructed a grid of radial arcs, for which superior results are claimed, an illustration being given. B. J. L.

***4215. U.V. Dosemeter for Therapeutic Use. R. Latarjet.** *Rev. d'Optique*, 16. *pp.* 169–187, *May*, 1937.—The apparatus described is a modification of the method used in physical practice for the photometric measurement of heterogeneous u.v. radiations. It consists essentially of a quartz spectrograph and a non-selective photoelectric detector. The outlet of the spectrograph is fitted with a stop, the aperture of which is designed to allow the selective transmission of erythema producing radiations only. Tests described show that the sensitivity curve of the instrument follows very closely the erythema/wave-length curve. The photoelectric cell is covered with a fluorescent screen of sodium salicylate, thus rendering it non-selective over a large range of wave-lengths. The apparatus may be calibrated in energy units. J. E. R.

4216. Spacial Distribution of Radiation from a Supervoltage X-Ray Tube and its Significance in Therapy. K. E. Corrigan and B. Cassen. *Am. J. of Roentgenology and Radium Therapy*, 37. *pp.* 811–818, *June*, 1937.—The intensity of hard X-rays is not uniform in space around the target of an X-ray tube. Theoretically, as shown, the shorter wave-lengths reach maximum intensity at a certain angle to the axis of the kathode ray, and this maximum tends to move forward with increase of voltage. This was first observed for low voltages in 1909. The authors have investigated this phenomenon for hard rays developed at 500 kV, and find the maximum occurs about 18° from the tube axis, the intensity at this angle after heavy filtration being about 3 times as great as at an angle of 90°. The practical result is that, in order to use the hard radiation from a h.v. tube, the beam must be emitted at a small angle to the tube axis, the effect being greater at higher voltages. This phenomenon explains the varying results of filtration and measurements of depth dose intensity. The theoretical calculations which are given are confirmed by the experimental findings described. B. J. L.

4217. X-Ray Absorption by the Skin. H. L. Brose and E. H. Molesworth. *Brit. J. of Radiology*, 10. *pp.* 567–570, *July*, 1937.—Experimental confirmation of the assertion that the angle of incidence of a beam of X-rays on the skin has little or no practical influence upon the dose actually absorbed in tissue lying immediately below the surface irradiated, has been obtained by a method previously described [see Abstract 1842 (1937)]. It might be assumed by analogy with visible light, that the absorbed radiation varies with the cosine of the angle of incidence, but as the intensity of a beam of X-rays is only very slightly reduced in its passage through the skin, the effect is then very small. Strips of photographic films were exposed for 5 sec., supported by blocks of wood at angles of 45°, 60° and 80° at 20 cm.focus/skin distance from a 100-kV X-ray tube. Upon comparing the blackening of the film by a photometric method it was found that the amount of X-radiation absorbed at these angles differs by less than 10% from that which is absorbed when the X-rays are incident normally. T. A. C.

See also Abstracts 3869, 4093.

OSCILLATIONS AND WAVES.

4218. Bright Solar Eruptions and Radio Fading, 1935-1936. H. W. Newton and H. J. Barton. *Roy. Astron. Soc., M.N.* 97. *pp.* 594–611, *June*, 1937.—The paper makes a comparison between the times of occurrence of sudden short-wave radio fadings and of bright eruptions observed spectrohelioscopically on the sun in hydrogen light (Hα) or in that of Ca^+ (H and K). Certain characteristics of the radio fadings themselves suggest that they are related to radiation from the sun. The comparison made with the solar eruptions shows a close correlation between the two phenomena, especially in the case of the largest eruptions, and implies a solar agency (indicated visually by bright eruptions) travelling from limited parts of the chromosphere with approximately the speed of light, and causing terrestrial ionospheric disturbances. The question of a tendency in the radio observations towards a periodicity corresponding to the solar rotation is examined, as well as the possibility that terrestrial magnetic effects accompany the radio fadings. The results from the limited data available are inconclusive in both cases. Suggestions are made for extending both radio and solar observations during the coming maximum of solar activity. A. Hu.

4219. Terrestrial-Magnetic and Ionospheric Effects Associated with Bright Chromospheric Eruptions. A. G. McNish. *Terr. Mag.* 42. *pp.* 109–122, *June*, 1937.—Simultaneous magnetic changes (at a large number of stations) and bright chromospheric eruptions indicate the effect as due to increased atmospheric ionisation by the u.v. light from the eruption. Radio fade-outs occurring at the same time indicate that this increase of ionisation takes place at the base of or below the E-layer, while the upper layers are unaffected. It is suggested that the normal radiation from the sun in the extreme u.v. is much greater than that calculated on the assumption that the sun is a black-body radiator at a temperature between 6000° and 7000° K. Statistical examination of the phenomena suggests that differences in intensity may be an adequate explanation for the production of magnetic effects and radio fade-outs by some eruptions, only fade-outs by others, and absence of noticeable terrestrial effects in numerous cases. Fade-outs reported when no eruptions occurred seem attributable to causes of a different nature. F. S. B.

4220. Group Velocity Curves of Radio-Wave Propagation in the Ionosphere. R. R. Bajpai and K. B. Mathur. *Indian Journ. Phys.* 11. *pp.* 165–175, *July*, 1937.—Group velocity curves are drawn for several different frequences for radio-wave propagation in the ionosphere at Allahabad, showing how the velocity varies as the waves enter regions having greater and greater electron density. The effect of collisional friction is not taken into account. Curves are drawn for frequencies $p>p_N$, $p_L<p<p_N$, $p_T<p<p_L$, $p<p_T$, in this case $p_T<p_L$. The boundary curves between various classes are also illustrated. The curves show that the number of points at which group velocity becomes zero is larger than the points where the refractive index becomes zero and thus they show that there is one more possible condition of reflection over and above the usually accepted ones. The reflections corresponding to the new condition in the case of short waves have been obtained. AUTHORS.

4221. Ionosphere Observations during June-July, 1936. S. Teteibaum. *Techn. Phys., U.S.S.R.* 4. 3. *pp.* 200–223, 1937. *In English.*—Measurements were made at Kiev of the virtual height of the various layers reflecting radio waves and of the ionisation during the partial solar eclipse on June 19th, 1936. During the eclipse the charge density in the F-region was reduced by 45% for a time-interval extending approximately from 30 min. before to 10 min. after the time of maximum phase. Similarly, for the F_2-region, a reduction of 36% of the charge density was observed for a period 40 min. before to 20 min. after the time of maximum phase. After the eclipse the virtual heights of reflection were greater than usual up to the evening maximum of charge concentration. It is concluded from measurements of the magnetic-electronic separation of the signals that at virtual heights of 300 km. and more the space-charges are principally electronic in character. Evidence was obtained of the presence of ions in appreciable quantity at heights of 200–230 km. A. W.

See also Abstracts 4141, 4225.

PHOTOELECTRICITY.

4222. Photoelectric Measurements on Sb. R. Suhrmann and W. Berndt. *Zeits. f. Physik,* 106. 5–6. *pp.* 354–357, 1937.—The results of Middel [see Abstract 2848 (1937)] are criticised after a comparison with those of the authors [see Abstract 1427 (1936)]. They suggest that the metallic layers used by Middel are partly in the non-metallic state and they state that they have found that the inner photoelectric effect of purely metallic Sb layers is extremely small. They do not agree that the sign of the temperature coefficient is negative and they adduce evidence from a number of other workers in support of their remarks. H. J. H. S.

See also Abstracts 3796, 3797, 3829, 3897, 4013, 4163, 4227.

PIEZOELECTRICITY.

4223. Effect of Temperature on the Piezoelectric Modulus of Quartz. Part II. A. Langevin and (Miss) A. M. Moulin. *J. de Physique et le Radium,* 8. *pp.* 257–259, *June,* 1937.—Continuing a previous investigation of the piezoelectric modulus of quartz up to 200° C. [see Abstract 2450 (1936)], measurements are now made at temperatures between + 23° C. and − 60° C. The modulus remains constant between + 20° and 0° C., and then decreases linearly down to − 60°. In this temperature range the modulus varies by 58 parts in 1000. C. J. B. C.

THERMIONICS.

4224. Secondary-Electron Emission from Complex Surfaces. L. R. G. Treloar. *Phys. Soc., Proc.* 49. *pp.* 392–407 ; *Disc.,* 408, *July* 1, 1937.—The secondary emission from metals on whose surfaces foreign substances (*e.g.,* electropositive metals) have been deposited to various thicknesses up to a few atomic layers has been studied. It is shown experimentally that for sufficiently thin films of the contaminant the secondary emission for a given base metal depends only on the work function of the surface, and not at all on the nature of the contaminant. The form and magnitude of the variation of secondary emission with work function agree with those calculated from the energy-distribution of secondary electrons. From a study of thicker films information is obtained concerning the mean depth of liberation of secondary electrons. The significance of the results in connection with more complex secondary-emitting materials is discussed. AUTHOR.

4225. " Island Formation " in Valves. H. Bode. *Zeits. f. techn. Physik,* 18. 1. *pp.* 191–198, 1937.—The surface of the kathode of an amplifying valve may be considered as composed of 3 types of surface, F_1, F_2 and F_3. The F_1 surfaces are those which, as a result of positive fields, do not emit (" islands ") ; the F_3 surfaces are those which emit the saturation current and the F_2 surfaces, which usually surround the F_3 surfaces, are those which, as a result of space-charge effects, do not emit the saturation current owing to the return to the kathode of a number of the electrons. The conditions necessary for the formation of " islands " is briefly summarised and their effect on the valve characteristics is mentioned; their effect increases as the irregularity of the static charge distribution on the kathode increases, and it is especially large in the so-called plate valves in which a hot kathode is arranged between 2 parallel plane plates, one serving as the anode and the other as the grid. An example is given of the calculation of the field (homogeneous) of such a valve as well as the potential surfaces of an unsymmetrical arrangement of the electrodes. The potential surfaces are also calculated for the valve, assuming the current density proportional to the static field-strength and also to the square of this field, and the results are compared with the measured quantities for low and high saturation currents. H. J. H. S.

4226. Electric Field Influence on Surface Ionisation. L. N. Dobrezow. *Phys. Zeits. d. Sowjetunion*, 11. 6. *pp.* 647–659, 1937. *In English.*—The influence of the electric field is studied on the degree of ionisation $n^+/n^\times$ at different temperatures on a W surface, on which surface ionisation of K and Na is taking place. The results obtained are compared with the theory developed by Morgulis, and the difficulty is illustrated of applying this theory to the explanation of the results. The possibility of interpreting the field influence on the degree of ionisation as the Shottky effect on the ions is ascertained. The field influence on the constant coefficient in the Langmuir-Saha formula is established. AUTHOR.

4227. Photothermionic Effect in Incandescent Metals. I. Ranzi and R. Ricamo. *N. Cimento*, 14. *pp.* 114–118, *March*, 1937.—When a glowing filament is subjected to white light the thermionic effect is apparently increased. Vercelli [see Abstract 4022 (1935)] put this down as a photoelectric effect causing a displacement of the threshold value to 4000 Å. Experiments have been carried out using triode valves, joining the grid and plate and illuminating the filament by passing the light through various filters from a powerful source. The intensity of the light, the plate current and the resistance of the filament are measured and the conclusion drawn that, for pure W, the effect is merely due to heating of the filament, whereas in filaments covered with thorium oxide, the photoelectric effect is also present. H. M. B.

THERMOELECTRICITY.

4228. Benedicks' Electrothermic Homogeneous Effect. W. Band. *Cambridge Phil. Soc., Proc.* 33. *pp.* 385–389, *July*, 1937.—In their work on Hg Benedicks and Sederholm observed that the small temperature peak near the middle of the long tube containing the conductor was displaced in one direction or the other along the tube according to the direction of flow of the electric current by which the conductor was heated. Normally this effect increased with the cube of the current intensity, and was explained as due to Thomson heat. If the temperature was made as uniform as possible by means of controlled heaters at the ends of the tube the effect became of opposite sign and increased linearly with the current. This was called the electrothermic effect and was explained as due to an actual change of thermal equilibrium by the electric current, or the production of a temperature gradient by a flow of electricity. The present paper shows that this new hypothesis is quite unnecessary, the complete effect being easily explainable in terms of the Thomson heat alone, provided that the full state of affairs is taken into account as regards thermal processes going on in the conductor. J. J. S.

See also Abstract 4104.